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## USSR Report

BIOMEDICAL AND BEHAVIORAL SCIENCES

(FOUO 5/81)



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On behalf of all of us in FBIS I wish to express appreciation to our readers who have guided our efforts throughout the years.

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USSR REPORT  
LIFE SCIENCES  
BIOMEDICAL AND BEHAVIORAL SCIENCES  
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HUMAN FACTORS

UDC 612.822.3.087

EEG-CORRELATES IN HEART-RATE VOLUNTARY-CONTROL TRAINING IN MAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian No 6, 1980 pp 1487-1490

[Article by A. N. Borgest, M. I. Talan, and Academician V. N. Chernogovskiy, USSR Academy of Sciences Institute of Physiology imeni I. P. Pavlov, Leningrad, submitted 26 Sep 79]

[Text] During the past decade the alluring prospect of voluntary control of the autonomic functions in man has stimulated extensive research on biofeedback control [bioupravleniye] on heart rate. At this time, however, the question is far from solved. Up to now there has been no convincing proof of the "validity" of training and the possibility cannot be excluded that the changes observed are secondary and result from voluntary regulation of other functions.<sup>1</sup> Moreover, the facts concerning the correlation between the various components of the EEG and heart rate, obtained during training to control the bioelectrical activity of the brain,<sup>2-5</sup> are contradictory. Information in the literature on the interconnection between EEG processes and voluntary control of heart rate is scant. In order to resolve these questions it was of importance to study EEG changes during the process of training healthy subjects to control heart rate voluntarily.

Studies were done on 4 volunteer students (2 men and 2 women) aged 18 to 20. A conditioned "avoidance" reaction convenient for studying EEG-correlate models was selected. During the studies the subjects were under hypnosis (stage 2) making it possible to impart suggestions aimed at muscular relaxation and enhanced motivation to carry out tasks, and this created the most favorable conditions for training of the autonomic functions.<sup>6</sup> A I-lead EKG, respiration, and an EEG covering the frontal, somatomotor and occipital fields (monopolar) were recorded on a Nihon Koden encephalograph with an analyzer and integrator (integration time 10 seconds). A 15-second 1-kHz tone 65 dB above the threshold of human hearing was used as the signal to carry out the task.

Evaluation of heart rate and of task fulfillment relative to EKG was done on an MN-7M machine. If the task was not executed immediately after the sound signal had ended the subject was "punished"--a weak 2-second electric shock was applied to the skin on the knee at a frequency of 1 kHz for 0.5 msec., exceeding the pain threshold but not causing motor reaction. Conditioning signals were generated every 45 seconds. Amplitude readings of the integrated EEG spectrum and pulse were taken during the last 10 seconds of the tone (test reading) and during the intervals between the signals (control readings). Each 45-minute training session included 60 test readings alternating with 60 control readings. Up to 20 baseline

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readings of the EEG and EKG were taken before and after training sessions. The material obtained was statistically processed on a Wang-2200 digital computer using the Student t-statistic to find the reliability of the differences in the studied parameters in test and control readings during the training period, and also initial baseline and test readings.

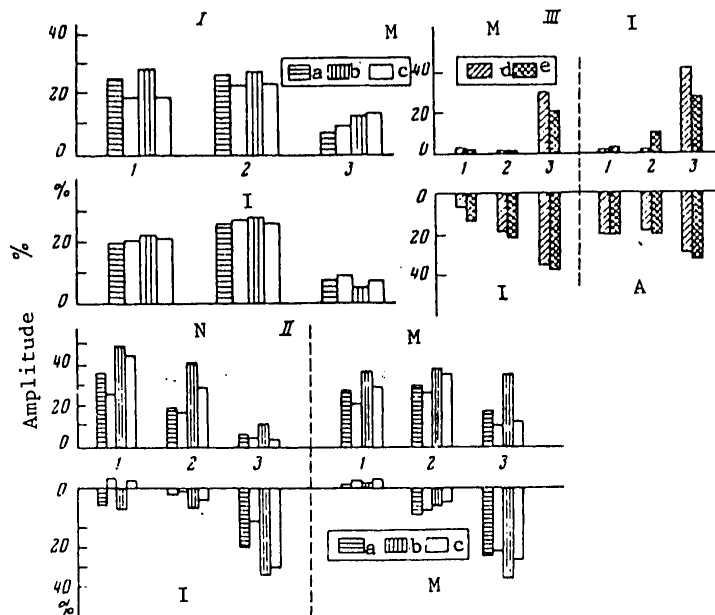


Figure 1. Change in Amplitude of Integrated EEG Spectra Compared with Initial Baseline with Given Change in Heart Rate (I), in training for Voluntary Control of Heart Rate (II), in Spontaneous Variations in Heart Rate in Baseline Readings Before and After a Training Period (III),

1 - delta. 2 - theta. 3 - alpha. I - Subject M. Increase in heart rate of 6/min,  $C_4$  lead; subject I. Decrease in heart rate by 1.6/min,  $F_4$  lead. a - averaged data for all test readings in the experiment. b - test readings with statistically reliable changes in pulse ( $p < 0.001$ ). c - control readings without training. II - Subjects N and M. Increase in heart rate of 7.2 and 9 beats per minute respectively; lead  $P_4$ . Subjects I and M. Decrease in heart rate by 8.4 and 5.2 beats per minute respectively,  $O_2$  lead. a, b, c. - as for I. III - Subjects M and I. Increase in heart rate of 4.2 and 8.6 beats per minute respectively. Subjects I and A. Decrease in heart rate by 9.2 and 8.2 beats per minute respectively. d -  $O_2$  lead. e -  $C_4$  lead.

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Three series of investigations were conducted: 1) with an unspecified set-up to alter heart rate; 2) training to accelerate heart rate; 3) to slow heart rate in order to avoid "punishment." No significant differences were found for the EEG pictures for test and control readings in the training period in all series of observations. Taking into account the insignificant interval between these readings, it is suggested that a certain inertia in the autonomic processes was also reflected in the interial nature of the EEG patterns.

Later, material will be presented from comparison of test readings with baseline readings.

In the first series of investigations, half of the subjects coped with the task. Analysis of the EEG showed that regardless of whether or not the task was fulfilled, in all subjects during the training period there was an increase in the amplitude of the integrated spectra for delta or theta waves amounting to 25 to 30 percent ( $p < 0.5$ ) in the frontal and central fields (figure 1, I).

During training to voluntary increase heart rate, task fulfillment was accompanied in most cases by reliable ( $p < 0.5$ ) increase in the output of delta and theta waves amounting to 26 to 52 percent, as in the preceding series (figure 1, II, 1,2, subjects N and M). The tendency toward increase in the slow-wave section of the EEG spectrum in all lead zones also appeared when actual fulfillment of the task was not completed. In subjects who coped most successfully with voluntary regulation of pulse, there was also simultaneous increase in the amplitude of integrated values for the alpha spectrum (figure 1, II, 3, subject M).

During training to slow heart rate, there were no significant changes in delta and theta rhythms in the process of task fulfillment, but in half the training sessions there was a reliable 20- to 59-percent decrease in the amplitude of the integrated alpha spectrum,  $P < 0.05$  (figure 1, II, subjects I and M).

As control, spontaneous changes in heart rate and EEG were analyzed in baseline readings before and after the training period. It turned out that, similar to during training, the amplitude of the integrated alpha spectrum reveals a certain interconnection with heart rate, and in 63 percent of cases grows during heart rate increase and falls during heart rate decrease (figure 1, III). This agrees with data obtained during a study of diadaptive regulation of alpha rhythm.<sup>5,7,8</sup> We did not succeed in finding a precise correlation between absolute magnitudes of heart rate and the output of the alpha spectrum. It is probable that changes in the latter may reflect transitory processes in pulse dynamics.

Whereas alpha waves were characterized by identical changes during baseline and training periods, the slow-wave components of the EEG remained almost unchanged during spontaneous increase in heart rate, in contrast to the training period; and in spontaneous slowing of heart rate, on the contrary, they were significantly reduced ( $p < 0.01$ ). It is known that theta rhythm genesis is largely associated with the limbic system.<sup>9,10</sup> The latter, in turn, bears a direct relation on the organization both of visceral and emotional behavior.<sup>12,11</sup> As a hypothesis it may be suggested that the changes in theta rhythm during heart rate training reflect very complex relationships. On the one hand, there are the emotional influences in the set-up, leading, according to our data, to increased output in the theta spectrum; and on the other, there is the restructuring of the autonomic

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functions (slowing or increasing pulse), which is also reflected in the presentation of the theta rhythm.

These kinds of relationships may show that in different set-ups, subjects employ different strategies in training, and as a result involve different mechanisms in the process of biological adaptation.

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VISUAL INFORMATION AND VISION OF ROBOTS

Moscow VIZUAL'NAYA INFORMATSIYA I ZRENIYE ROBOTOV in Russian 1979 signed to press 29 May 79 pp 2-6, 176

[Annotation, preface and table of contents from book by Georgiy Petrovich Katys, Izdatel'stvo "Energiya", 5500 copies, 176 pages]

[Text] The book examines the principles of constructing systems for processing visual information. Systems are compared and the main characteristics and fields of application are indicated. The potential of visual information processing systems is demonstrated for enhancing the autonomous nature of robots and extending their capabilities and spheres of application.

The book is intended for engineering and technical personnel specializing in the field of automatic systems, cybernetics and data processing problems.

Preface

Expansion of the possibilities and spheres of application for robots at the present stage of development in robotics engineering is associated with the need for intensive development of facilities for perceiving and processing information about the environment and for equipping the robot with greater autonomy. It should be noted that the problem of data handling by a robot is of extreme significance in the total complex of problems arising when drawing up the structural scheme and general configuration of a robot. The level of autonomy achieved for the robot largely depends on how comprehensively this problem is tackled. As is known, for normal functioning in an unstable environment, an autonomous robot must perceive and process broad flows of visual, tactile, audio and other information. Visual information is of basic significance in this complex of data flows. The importance of visual data in the control of an autonomous system is confirmed by the fact that a human being obtains about 85 percent of the data he needs through the visual channel.

It could be said that visual analyzers are the main channels by which a robot communicates with the external world; the main flow of information essential for its control passes through these channels. Accordingly, the selection of rational principles for constructing and optimizing the structural schemes and parameters for such devices, and also the creation of self-adjusting visual systems possessing the properties of adaptation to the changing characteristics of the external environment, constitute an important problem.

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In this book we examine the set of problems and questions associated with the various aspects of perception, processing and utilization of data in order to control a robot. Ways of selecting rational principles for constructing visual systems and methods of determining parameters for the structural schemes of such systems are examined. Various aspects of perceiving and processing visual data at the different hierarchical levels in the visual analyzers of robots are analyzed. In connection with the development of second- and third-generation robots, there has recently been intensive work on developing visual systems capable of carrying out quite complex actions in recognizing external objects and orienting themselves among them.

Various methods of data processing are used in the development of visual organs for robots, including methods of processing and discriminating among monocular images, methods of handling stereoscopic images, and methods of separating light arrays and so forth. These methods of analyzing visual data are examined in the various chapters of the book.

Marked successes have recently been achieved in the field of bionics research on the organs of sight in animals. Judging from the literature and the patent publications, the results of this research are making it possible to move on to the development of technical devices that model some of the functions of the organs of sight. It is these circumstances that have prompted the author to examine this complex of topics. The book examines the results of bionic research on the functionally original organs of sight in some animals. An analysis is made of the various aspects of the perception and processing of visual data in the organs of sight in living organisms, and also of the possibilities and ways of modeling specific functions of the visual analyzers in technologic systems.

It is known that selection, filtration and identification of visual data of value to an animal are accomplished sequentially at the various levels of the visual analyzer. The filters discriminate contours, straight lines and boundaries in a specific orientation, moving objects and so forth that appear on the images. Technologic models have recently been developed that realize some of these functions. In the book the functional and structural schemes of various sign detectors (detectors for moving objects, contours, lines and so forth) are examined, and their parameters and characteristics are shown.

Semiconductor, step-matrix and television technologies integrated with fiber optics and integrated optics form the technical basis for realizing the bionic principles of analyzing and converting visual data.

On the basis of analysis of published material the author has attempted to provide one of the possible extrapolations in the future status of some avenues in the development of visual systems for robots. This attempt has been made on the basis of analyzing patents, certificates of invention and various publications containing information on the possible directions in future developments. It should be noted that it is precisely this material that after a given lead-time will be reflected in the technical realization of systems in the class being examined.

At this time there are, unfortunately, no books in which all the material on this topic published in periodicals and patent publications has been generalized and analyzed. The book now called to the reader's attention is called upon to fill this gap.

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The aim of the book is to provide the reader with an overall idea of the ways and prospects in the development of a class of visual analyzers for robots carrying large amounts of data, and also of the corresponding directions in coherent technology, the techniques of spatiotemporal image filtering, bionic processing systems and discrimination methods, together with the present-day methods of photoelectric image analysis. The book contains a classification of visual analyzers for robots and an examination of the principles involved in their construction, together with structural schemes and data characteristics. Indications are given for the possible ways of utilizing bionic principles for processing visual data when developing structural schemes for visual analyzers for robots. The material presented provides the reader with a good idea of the various principles involved in constructing visual analyzers for robots and the methods of selecting rational structural schemes, together with ways of determining the parameters for such systems.

Being aware of the shortcoming of the book the author thanks readers in advance for all comments, which should be sent to the following address: 113114, Moscow, M-114, Shlyuznaya naberezhnaya 10, Izdatelstvo "Energiya".

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ANNOTATION AND ABSTRACTS FROM 'PROBLEMS OF BIONICS'

Khar'kov PROBLEMY BIONIKI in Russian No 19, 1977 pp 1 - 4 with annotation

[Following are abstracts and the annotation appearing in the anthology "Problems of Bionics" edited by A. P. Guzhva and prepared by the editorial board of the Khar'kov Institute of Radioelectronics]

[Text] This anthology is addressed to the problems of a mathematical and physical simulation of the processes involved in processing information at various levels of the nervous system. Certain aspects of human intellectual activity and the ability to reproduce elements of this activity in man-made mapping and control systems are explored for the first time. The latter is especially important in light of the vast goals that the 25th CPSU Congress has set for Soviet scientists. The processing of verbal information, discrimination of visual images and psychological aspects of the activity of operators of complex systems are also described.

It is intended for scientific workers and specialists in the fields of cybernetics, computer technology, biology and medicine.

UDC 62.502.2

QUALITATIVE ANALYSIS OF THE DYNAMIC PROPERTIES OF NEURON NETWORKS MADE UP OF ADAPTIVE ELEMENTS. REPORT 2.

[Abstract of report by V. N. Yefrimov, A. V. Klimenko and T. M. Bogatyreva, pp 3 - 8]

[Text] Networks of analogous adaptive neurons are examined. The two-stage technique of analyzing the dynamics of neuron networks was employed and an analysis was made of networks of the closed contour type with excitatory connections and with inhibiting connections.

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Diagrams of neuron network conditions are included which make it possible to define the dynamic properties of a neuron network as a whole on the basis of fixed elemental parameters and maximum structural parameters. 1 illustration, 4 references.

UDC 62—506.222

EMOTIONS FROM THE STANDPOINT OF BIOCYBERNETICS

[Abstract of article by P. S. Grave, pp 8 - 11]

[Text] The biological significance of the emotional sphere is analyzed. A schematic block model of the structural associations of emotions is set within the framework of integral psychics. 1 table.

UDC 62.506.2

CLASSIFYING INTELLECTUAL GOALS. REPORT 1.

[Abstract of report by V. M. Bondarev and V. A. Lovitskiy, pp 11 - 19]

[Text] The potential ability to classify goals on the basis of defining the concept of "goal" proposed in the article is explored. A survey of a number of the existing definitions and means of classifying goals is given. 3 tables, 2 illustrations, 19 references.

UDC 62.506.2

THE VISUAL ANALYZER AS A MULTI-CIRCUIT BIOLOGICAL SYSTEM OF ASSOCIATED AUTOMATIC CONTROL

[Abstract of article by V. F. Ananin, pp 19 - 27]

The visual analyzer is discussed as a biological variant in a multi-circuit system of associated automatic control.

The circuits for controlling the pupillary and accommodation reflexes, the circuit for control of the receptive field which is a follow-up to the optical motor system, the circuit for controlling the dynamic range of the visual system and others are included in this system. 1 illustration, 11 references.

UDC 62.506.2

MATHEMATICAL DESCRIPTION OF HIERARCHICAL STRUCTURE

[Abstract of an article by Yu. V. Isichenko, Yu. V., L. P. Popova and L. D. Donin, pp 27 - 31]

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[Text] An approach to structuring a mathematical model of hierarchical structure based on the precepts of the theory of multiples is described. Here, an algebraic model structure is matched to the levels in the hierarchy (the multiple M with a number of relationships to it). Homomorphisms of the model correspond to the associations between the levels. 3 illustrations, 2 references.

UDC 62.506.2

THE EFFECT OF SMOOTHING ON HEARING

[Abstract of article by O. M. Abramov, A. Ya. Dryuchenko, S. A. Usenko, Yu. P. Shabanov-Kushnareko, pp 31 - 37]

[Text] The issue of the applicability of Talbot's generalized law to hearing is examined. Experiments that were run have proven the correctness of Talbot's law for hearing in terms of sonic pressure. 4 illustrations, 3 references.

UDC 62.506.2 + 4R

ON THE QUESTION OF STRUCTURING AN ALGORITHM OF THE SYNTHESIS OF VERB FORMS IN THE RUSSIAN LANGUAGE

[Abstract of article by A. I. Chugun and T. A. Nedzel'skaya, pp 37 - 42]

[Text] A method of structuring a model for the synthesis of word forms outside the relationship of their context is discussed and an algorithm for the synthesis of the personal forms of non-reflexive verbs in the Russian language from the infinitive form is proposed. 1 table, 2 illustrations, 4 references.

UDC 62.506.2

THE PROBLEM OF ORDERING NUMERICAL MASSES BY MAN AND COMPUTER. REPORT 1.

[Article by S. I. Shapiro, S. V. Tsekhoi and A. V. Kornev, pp 42 - 55]

[Text] Various techniques of ordering numerical masses by man and computer are examined and the appropriate machine programs are presented. A structural theoretical-informational model of the mechanism of ordering describes the solution to the problem of machine ordering based on the technique of separation into submasses: fractional ordering, joining, the refinement function  $T(p)$ . 3 tables, 1 illustration, 3 references.

UDC 62.506.2

THE PROBLEM OF ORDERING NUMERICAL MASSES BY MAN AND COMPUTER. REPORT 2.

[Article by S. I. Shapiro, Ye. N. Shilova and T. D. Barnagyan, pp 55 - 64]

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[Text] A massive experiment with man in determining the dynamics of the function  $T(p)$  in resolving the problem of ordering a numerical mass by breaking it down into submasses is described. The logic coordinates of a computer program and human heuristics are compared. The high positive correlation of the function  $T(p)$  resulting from the theoretical-informational model is confirmed experimentally for man and computer on a micro-level (for the elementary processes of frequency ordering and joining) as is the low degree on the level of integral processes where human mechanisms are specifically understood in full measure. 7 tables, 1 illustration, 2 references

UDC 62.506.2

PROPERTIES OF A REPRESENTATION AND BIOLOGICAL SIMULATION OF THE NERVOUS SYSTEM. REPORT 7.

[Abstract of article by Yu. P. Bugay, pp 65 - 72]

[Text] Functional and structural diagrams of structures that make it possible to realize the isolation of a whole number of relationships between the elements of the situation being depicted. The potential for using such structures is discussed. 1 illustration, 2 references

UDC 62.506.2

PROPERTIES OF A REPRESENTATION AND BIOLOGICAL SIMULATION OF THE NERVOUS SYSTEM. REPORT 8.

[Abstract of an article by Yu. P. Bugay, pp 72 - 81]

[Text] A comparative analysis was made of the properties of the relationships and other possible means of determining the properties of the relationships needed for a more detailed descriptions of the situations to be depicted in terms of elements and relationships. Functional analogy of the procedures described through integral-differential equations is discussed as is that of the procedures described in terms of the elements and relationships between them. 1 table, 2 references

UDC 62.506.2

A GENERAL CLASSIFIER FOR PERSONAL FORMS WITH RESPECT TO HOMOGRAPHY

[Abstract of an article by Ye. A. Solov'yeva, pp 81 - 88]

[Text] A mathematical model has been proposed for the functions realized in the process of morphologically classifying personal verb forms based on indicators from all the inherently grammatical categories. The model is universal, makes allowance for instances of full or partial coincidence of personal forms and utilizes the minimally necessary information about formal word structure.  
3 tables, 11 references

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UDC 62.506.2

IN CONSIDERATION OF A SINGLE METHOD OF CLASSIFYING VERB FORMS IN THE RUSSIAN LANGUAGE BY TYPES OF CONJUGATION

[Abstract of an article by A. I. Chugun, pp 88 - 92]

[Text] Current models of man's abilities to classify personal verb forms in the Russian language by types of conjugation are proposed. 1 table, 1 illustration, 6 references

UDC 614.1:313.13

FREQUENCY ANALYSIS OF ELECTROGRAMS DEFINED BY UNITARY CODES

[Abstract of an article by I. D. Ponomareva, pp 93 - 97]

[Text] It has been demonstrated that analysis of a unitary code where the extreme moments are marked by impulses of a standard amplitude and duration is sufficient to isolate the periodic component as well as to evaluate the frequency components of a continuous stationary random function. Results of an analysis of a cerebral electrogram through the processing of unitary codes are presented. 4 illustrations, 4 references

UDC 612.821

SOME PSYCHOLOGICAL ASPECTS OF THE FUNCTIONING OF AN OPERATOR IN THE SEMICONDUCTOR INDUSTRY

[Abstract of an article by V. V. Sviridov, Ye. V. Bodyanskiy, I. M. Belaya and I. F. Kustov, pp 98 - 103]

[Text] The issues of developing a conceptual model of technological projects and the notions of decisions based on it are examined. The procedure for control is treated like a self-teaching process for the operator. 1 illustration, 2 references

UDC 62.506.2

DETERMINING ERROR IN COMPUTING A SINGLE FUNCTIONAL WHILE NORMALIZING SHIFTS IN TWO-DIMENSIONAL GRAPHS

[Abstract of an article by N. K. Sergeyeva, pp 103 - 108]

[Text] Aspects of the technical realization of a single algorithm of normalizing the shifts in two-dimensional graphs determined by set of point objects are investigated. 4 references

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UDC 581.1.03+577.3

ON DIAGNOSING THE FUNCTIONAL CONDITION OF PLANTS

[Abstract of an article by A. P. Pasichnyy, I. D. Ponomareva, G. B. Tsepkov and V. I. Lavrinenko, pp 108 - 113]

[Text] A technique for determining the functional condition of plants by analysis of the biosignals emitted from green leaves during intermittent changes in external conditions (illumination) is described. The method is based on an evaluation of quantitative values for the coefficients of differential controls through which the conversion processes in plants are described. The description is illustrated with specific examples. 1 table, 3 illustrations, 4 references

UDC 62.506.2

NERVOUS SYSTEM TYPES FROM THE STANDPOINT OF THE QUANTUM WAVE THEORY OF THE COHERENT BRAIN

[Abstract of an article by V. N. Chudakov, pp 113 - 116]

[Text] Central nervous system types are examined on the basis of the quantum wave theory of a coherent model of the brain. Functional relationships are plotted for the basic properties of nervous system types: the strength-weakness, mobility—inertia, equilibrium—imbalance of the excitatory and inhibitory processes in the nervous system. A chart of the diversity of nervous system types is presented with an allowance made for the interrelationship of classes of intellect and types of temperament. 1 table, 7 references.

UDC 621.3.049.75.001.2—5:621.383.93

AN OPTICAL-ELECTRONIC INSTRUMENT FOR LAYING ROUTES ON A MAP

[Abstract of an article by F. D. Dubinin, pp 116 - 119]

[Text] The structure and operational principle of a similar unit for the automatic laying of routes on an area map or printed plat is examined. The unit consists of uniform optronic plotting boards and a photoelectric recorder. 2 illustrations, 5 references.

UDC 681.142.36

MACHINE SIMULATION OF A CLASSIFIER FOR STANDARDIZED HANDWRITTEN SYMBOLS

[Abstract of an article by E. P. Chornostan, I. B. Sirodzha, pp 120 - 124]

[Text] A mathematical model of a classifying device is being introduced in the development of which the mathematical device of R-functions was utilized.

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An algorithm which simulates the work of a classifier is described and the results obtained via this algorithm are presented. 3 illustrations, 4 references.

UDC 62—523.8:621.1.033.3:621.383.93

USING A HOMOGENEOUS MODEL OF A BIOLOGICAL SYSTEM TO CONTROL THE COORDINATION OF A WALKING MECHANISM

[Abstract of an article by F. D. Dubinin, pp 124 - 130]

[Text] An optoelectronic mosaic model of a two-dimensional neuristor is examined as is its behavior in transient conditions.

An example of using the model to control a biosimilar mechanism with a cyclic operational rhythm is presented. 3 illustrations, 11 references

UDC 15.370.153

THE BIONIC METHOD OF CODING COMPLEX SIGNALS

[Abstract of an article by P. I. Chinayev, A. M. Shkvar, pp 130 - 137]

[Text] A technique has been developed to code a complex signal by breaking it down into informational indicators. An arrangement has been proposed for a functional automatic unit of an informal type in which high-precision coding of a signal takes place via the signal itself and its first two derivatives in time. 2 illustrations, 6 references.

UDC 62.506.2

CLASSIFYING NORMAL AND ANOMALOUS FORMS OF INTELLECTUAL ACTIVITY ON THE BASIS OF THE QUANTUM WAVE THEORY OF A COHERENT MODEL OF THE BRAIN. REPORT 2.

[Abstract of a report by V. N. Chudakov, pp 137 - 150]

[Text] The relationship between hereditary tendencies in the nervous system and talent is explored. Intervals of intellect are introduced. Conditions for self-organization in the neuro-psychical types of intellect are explained. A principle is formulated for incoherence which is a corollary to the principle of coherence in the information flow of wave signals among the neuron structures and which maintains the desynchronization and dispersion of these flows while leading to an initial independence in the activity of the individual neurons. An attempt is made to examine the relationship of the informational flows of wave signals in the Q and C structures of the brain of those that are highly coordinated. 10 references.

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ANNOTATION AND ABSTRACTS FROM THE JOURNAL 'PROBLEMS OF BIONICS'

Khark'kov PROBLEMY BIONIKI in Russian No 20, 1978 pp 1 - 4

[Following are abstracts and the annotation from the anthology "Problems of Bionics" edited by A. P. Guzhva and A. L. Aliyeva and prepared by the editorial board of the Kharkhov Institute of Radioelectronics, Ukrainian SSR Ministry of Higher and Middle Specialized Education]

[Text] This anthology is addressed to the problems of a mathematical and physical simulation of the processes involved in processing information at various levels of the nervous system. The various aspects of human intellectual activity are discussed. Results are described from studies of the processes of processing verbal information, discriminating visual shapes as well as the psychological aspects of the functioning of operators of complex systems. The questions of coding biomedical information are examined as are mathematical models of the spectral sensitivity of man's visual apparatus.

It is intended for scientific workers and specialists in the fields of cybernetics, computer technology, engineering psychology, biology and medicine.

Bibliographies are give at the end of the articles.

UDC 62—501.72

PRINCIPLES OF TRAINING IN SYSTEMS OF SITUATIONAL CONTROL

[Abstract of an article by A. A. Kryukov, A. B. Karunin, Yu. I. Klykov, M. V. Volchenko, pp 3 - 15]

[Text] Mechanisms of developing semiotic models in the process of training through examples are investigated in this work. Training is examined here as the interaction of micro- and macro-languages as a result of which, the formation of new concets takes place within the macro-language. A detailed description is provided of training programs oriented towards the structuring of

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semiotic models of systems in which the description of situations requires definition of a single basal relationship: the combination of wood systems.  
2 illustrations, 6 references

UDC 62.506.2

EXPERIMENTAL INVESTIGATION OF A MODEL OF INDUCTIVE COLOR CONTRAST

[Abstract of an article by Yu. P. Shabanov-Kushnarenko, V. Ya. Serdyuchenko and V. A. Grabina, pp 15 - 23]

[Text] Methods for conducting and the results from experiments involving an investigation of a model of inductive color contrast are examined. 2 illustrations, 4 references.

UDC 62.506.2

DEDUCTIVE DERIVATION OF A MATHEMATICAL MODEL OF THE SPECTRAL SENSITIVITY OF THE HUMAN VISUAL APPARATUS. Report 1.

[Abstract of a report by V. P. Pchelinov, pp 23 - 31]

[Text] A method for setting up experiments that make it possible to obtain objective evidence while investigating the spectral sensitivity of the human visual organ is examined, conditions for the existence of color are formulated and a mathematical concept of color is introduced. Based on analysis of the properties of input signals of the visual apparatus, types of aggregation of these signals which are viewed as  $L_2$  spatial elements are determined. 3 illustrations, 5 references.

UDC 62.506.2

DEDUCTIVE DERIVATION OF A MATHEMATICAL MODEL OF THE SPECTRAL SENSITIVITY OF THE HUMAN VISUAL APPARATUS. Report 2.

[Abstract of a report by V. P. Pchelinov, pp 32 - 42]

[Text] The problems of proving the theorems that define the linear properties of a function realizing the transformation of input signals for the visual apparatus are examined in set of three numbers which serve as the coordinates of a color. A mathematical model of the spectral sensitivity of man's visual apparatus is derived by the deductive route, its objectivity and high degree of reliability are substantiated. 6 references.

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UDC 62.506.2

THE BRAIN AS A BIOLOGICAL SYSTEM IN A REAL SCALE OF TIME

[Abstract of an article by V. F. Ananan, pp 42 - 52]

[Text] An analogy is drawn between the biological system of the brain with its peripheral receptor apparatus and effectors and a technical system on a real scale of time. That these two systems have an essentially common structural system and an integral series of units that are analogous in their functional purpose is demonstrated. 1 illustration, 10 references.

UDC 681.142.36

PARAMETERIZING DESCRIPTIONS OF COMPLEX DEPICTIONS AS A TECHNIQUE OF THE CONTROLLED COMPRESSION OF INFORMATION. REPORT 1.

[Abstract of a report by V. P. Romanov and V. M. Kiselev, pp 53 - 58]

[Text] A mathematical model of the visual analyzer is examined. It is demonstrated that the problem of compressing graphic information can be resolved by composing a description of a picture in the form of functions that are fixed in contour and by selecting standardized forms to identify segments of the contour. 2 references.

UDC 681.142.36

PARAMETERIZING DESCRIPTIONS OF COMPLEX DEPICTIONS AS A TECHNIQUE OF THE CONTROLLED COMPRESSION OF INFORMATION. REPORT 2.

[Abstract of a report by V. P. Romanov and V. M. Kiselev, pp 59 - 69]

[Text] Characteristics of the progressive analysis of contoured depictions are examined. Recommendations are given as to the use of techniques of selective regression and a program of adaptive progressive analysis and identification of curve sectors is presented. 1 illustration, 4 references.

UDC 62.506.2

THE PROBLEM OF OPTIMUM HIGH SPEED RESOLVED BY THE NEURAL CELL

[Abstract of an article by V. S. Em, V. G. Pak, pp 69 - 79]

[Text] Structuring of a mathematical model of the kinetics of the metabolic processes which make allowance for the elementary structural organization of a cell has shown that a nerve cell solves the problem of the optimum high speed by the self-reorganization of probable ensembles: at the points which lie below the gamma line and within the  $\alpha_0^+$  trajectory, there is a refinement of

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the ensembles; at the points which lie above the gamma line and within the  $\alpha_0$  trajectory, there is a process of enlarging the ensembles. No more than one switchover is proven here for each optimum trajectory. 1 illustration, 10 references.

UDC 62.506.2

A BIOTECHNICAL SIMULATOR OF THE HUMAN VISUAL APPARATUS

[Abstract of an article by V. F. Ananin, pp 79 - 86]

[Text] A functional diagram for a biotechnical simulator which includes an optical arrangement, scanning unit, photomosaic, amplifier and electrode blocks has been developed on the basis of the mechanisms for the transformation and encoding of an outside stimulus in the retina of the human eye suggested earlier. 1 illustration, 10 references.

UDC 616.127—005.8—073.97

ON ENCODING BIOMEDICAL INFORMATION (USING AN ELECTROCARDIOGRAM DURING MYOCARDIAL INFARCTION AS AN EXAMPLE). REPORT 1.

[Abstract of a report by L. T. Malaya, V. G. Voronov, M. S. Mendlin, M. I. Kozhin, A. Yu. Gopp and A. Ye. Shul'man, pp 87 - 95]

[Text] Basic questions of translating biomedical information from the language of patient histories and laboratory records to the language and concepts of computers are examined in the example of EKG encoding. Primary attention is focused on the mutually synonymous correspondence of codes and baseline parameters as well as on the simplicity and standardization of translation. 7 tables, 1 illustration, 5 references.

UDC 62.506.2

CLASSIFYING NORMAL AND ANOMALOUS FORMS OF INTELLECTUAL ACTIVITY ON THE BASIS OF THE QUANTUM-WAVE THEORY OF A COHERENT MODEL OF THE BRAIN. REPORT 3.

[Abstract of an article by V. N. Chudakov, pp 95 - 105]

[Text] The role of sources for spontaneous self-stimulation of the CAN's within structures of the euro-reactive types is examined. The mechanisms for accumulating the genetic information of psychotisms is formally examined. The sources for the formation of informational energy among euro-reactive types are revealed. An analysis is made of psychotisms or the generators of spontaneous self-excitation of neuronal complexes and their involvement in the intellectual activity of the highly gifted is explained. 9 references.

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UDC 62.506.2

CLASSIFYING NORMAL AND ANOMALOUS FORMS OF INTELLECTUAL ACTIVITY ON THE BASIS OF THE QUANTUM-WAVE THEORY OF A COHERENT MODEL OF THE BRAIN. REPORT 4.

[Abstract of an article by V. N. Chudakov, pp 106 - 114]

[Text] A psychoeurotic relationship is introduced for the characteristics of the mutual relationship between the structures of psychotism (the generators of spontaneous self-stimulation of the neuronal ensembles) and the structures of giftedness. An analysis was made as was a classification of the highly-gifted intellect as a function of the psychoeurotic relationship. The transitions between the psychoeurotic structures in the highly talented are examined. The internal neurocybernetic mechanism of the PIG method is explained. 2 tables, 8 references.

UDC 62.506.2

A SINGLE LANGUAGE FOR THE FORMAL DESCRIPTION OF ALGORITHMS IN THE MORPHOLOGICAL PROCESSING OF UNITS OF TEXT

[Abstract of an article by E. M. Buznitskaya, pp 114 - 120]

[Text] A dual-level system has been developed for recording the algorithms of analysis and adjectival synthesis in the Russian language. In the first level, every algorithm is formed by means of a small reserve of verbal rules which have a fixed formulation. At the second level, there is a transition from the original notation to a meta-language. One of the variants of the applied calculus of predicates is used as the meta-language. 1 table, 6 references.

UDC 62.506.2

EVALUATING ERROR IN COMPUTING THE PARAMETERS FOR NORMALIZING THE ROTATIONS OF TWO-DIMENSIONAL PICTURES

[Abstract of an article by N. D. Sergeyeva, pp 120 - 127]

[Text] A number of algorithms for normalizing rotations of two-dimensional depictions are examined. An assessment of error is provided in computing the parameters of normalization for pictures fixed by an aggregation of point-like objects. A comparative assessment is made of the functions, forms of representation are shown for which the most effective algorithms are examined. 2 illustrations, 5 references.



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UDC 57:62—50

A MODEL REPRESENTATION OF THE FUNCTIONAL RELATIONSHIP BETWEEN TWO LEVELS OF A CONTROL SYSTEM

[Abstract of an article by V. A. Tumanyan, pp 127 - 132]

[Text] Several parameters and a number of conditions establishing the optimum control and functional interaction within the cortico-hippocampal system being studied in the process of forming and reinforcing acquired habits are examined and evaluated on the basis of experimental data. A model investigation makes it possible to refine the concept of the corrective effect of the hippocampus on the cortex during the initial stages of the development of temporal associations. 5 references.

UDC 351.814.33:62.506

DETECTING CONFLICT SITUATIONS DURING THE CONTROL OF AIR TRAFFIC IN AN AIRPORT ZONE

[Abstract of an article by P. P. Novikov and A. G. Paputo, pp 132 - 139]

[Text] An algorithm for detecting potentially conflicting situations has been proposed on the basis of a model for the making of decisions by an ATC dispatcher structured as a result of an experimental study of his activity. An analysis of the algorithm is indicative of its effectiveness as compared to other techniques for predicting conflicts. The accuracy of the bionic approach in developing mathematical support for complex systems of control has been confirmed. 1 table, 4 references.

UDC 62—501.72

STRUCTURING A SYSTEM TO FORECAST SOCIAL BEHAVIOR ON THE BASIS OF SEMIOTIC MODELS. REPORT 1. Stating the Objective. Frames.

[Abstract of a report by S. A. Filonik, pp 140 - 149]

[Text] An original approach to the construction of a system to forecast social behavior is underway. A social system is viewed as consisting of three component parts. The objective of predicting the system's behavior is formulated. Frames are defined and described as a convenient means for clearly visualizing the unexpressed in-depth concept of the texts (which describe the behavior of a social system) for the purpose of an adequate understanding of the original thought in these texts to obtain information needed to construct predictions. 1 illustration, 7 references.

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UDC 535.37.41

ELECTROCHEMICAL EMISSION IN ORGANIC SUBSTANCES AND ITS ROLE IN THE BIOLOGICAL PROCESSES. REPORT 3. Investigating the Possibility of Establishing Coherent Emission Based on the Appearance of Electrochemical Emission.

[Abstract of a report by N. N. Rozhitskiy and A. I. Bykh, pp 149 - 156]

[Text] The possibilities for realizing a mode of generation in electrophoretic compositions during their electrolysis that will make it possible to consider the establishment of such sources probable along with their use in simulating a number of processes in living organisms are explored. 1 illustration, 10 references.

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## TIME FACTOR IN HUMAN PERCEPTION DISCUSSED

Leningrad FAKTOR VREMENI V VOSPRIYATII CHELOVEKOM in Russian 1980 pp 2, 5-8, 96

[Annotation, table of contents and introduction from book "The Time Factor in Human Perception", by N.D. Bagrova, Izdatel'stvo "Nauka", 3,200 copies, 96 pages]

[Text] The monograph is dedicated to an important problem concerning the psychophysiology of work--the perception of time by man. The monograph presents the Marxist-Leninist conception of time as a methodological basis for an analysis of the natural sciences' concept of time. The study describes and analyzes the classical psychophysical methods of measurement and their field of application; it substantiates the optimal method of analysis in studies of the time factor in human perception. The study correlates the results of the author's experimental research, the literature data concerning evaluation of the human capacity for differentiation and scaling of the lengths of tonal sounds, and analyses of the human auditory analyzer's capacity for reflecting the lengths of tonal sounds in relation to the conditions of analysis (psychophysical method selected, standard length, individual characteristics, and other factors). The study examines the different forms of reflection of the time factor in human consciousness. It attempts to throw light on the physiological mechanisms that maintain the process of time perception by man. Literature: 209 titles; illustrations: 28; tables: 14.

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## Introduction

The age of scientific-technological progress is characterized by the rapid development of technology and automation and by the opening up of outer space and of the depths of the sea. At present, the establishment of automatic machine control systems does not aim at totally replacing man; on the contrary, it makes increasingly heavy demands on man's psychophysiological and psychological qualities. In our age, man must be able precisely to regulate his activities over time, satisfactorily orientate himself in this time framework and sufficiently accurately differentiate, perceive and evaluate the time-related characteristics of signals. This is related to the fact that most of the electronic measuring devices that are widely used in present-day technology are based on the operator's reading of the time-dependent characteristics of the signals; and in a number of communication systems, the time parameter is the most significant one as a means of codifying the information transmitted. In practice, the informative qualities of the signals' duration have been put to use in radiotelegraphic communication (Morse code), aviation, etc.

Analysis of the professional work of specialists of the operator type (radio and radar operators, machine operators) has shown that anticipatory or delaying actions during their work lead to errors and in some cases to dangerous situations. It is well known that different professional activities of the operators are effected by different psychophysiological functions. For example, the work of radio and sonar operators is determined primarily by the functions of the auditory analyzer; the work of radar station operators is determined by the functions of the optical analyzer, and the work of machine operators, by the functions of the motive analyzer.

Consequently, the industrial psychologists and physiologists are confronted with the task of studying the time factor in the work of operators of various types--both under customary conditions and under conditions subject to the influence of unfavorable factors characteristic of their work.

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As regards the study of the human capacity for gauging time intervals, there is a great deal of literature (49, 58, 70, 96, 100). At the same time, however, many of the problems pertaining to this question remain unsolved. Thus, if the characteristics of the perception of a number of stimulus parameters such as force, intensity and frequency are satisfactorily explored, then the duration parameter is insufficiently analyzed, even though the solution of many biophysical and biometrical problems is contingent upon knowledge of that question. The principal task confronting the researchers is to clarify whether in the perception of other parameters of physical signals the patterns of time perception are within the framework of the Weber-Fechner psychophysiological law which prevails within specific limits.

The present study represents theoretical and experimental data concerning the study of the precise quantitative principles of the reflection of time in human consciousness through analysis of the processes of sensation, discrimination and perception. This problem is solved through construction of natural scales of sound length by direct and indirect research procedures. Direct scaling is based on the methods of quantitative evaluation of the stimuli (181). The indirect scaling procedures are based (118) on the integration of the differential thresholds. Since the resolving power of the auditory analyzer is the principal psychophysiological quality distinguishing the professional work of specialists of the operator type (sonar operators, radio operators, etc.), a large part of the research in this study is devoted to investigating the characteristics of the perception of pulsed tone signals by man's auditory analyzer. A great deal of attention is given to the description of the psychometric methods of measuring the differential response and to the scaling procedures that of late have been used extensively in psychophysics and in sense organ physiology. Special attention is directed toward potential errors in the application of a given method of analysis.

The present study substantiates an optimal method of analysis that is adequate to the problems at hand. It is known that in evaluating time parameters, people inevitably make certain errors turning on the conditions of the experiment. Naturally enough, if one precisely determines--under various conditions--the patterns of reflection of the signal length in human consciousness, this will allow correction of the work results of a certain class of specialists of the operator type and it may be useful in the development of optimal methods of information transmission in the "man-machine" system.

The study presents the results of research concerning the time-dependent differential thresholds of man's auditory analyzer; it establishes the dependence of the differential threshold value on the length of the standard and on conditioning. The study verifies the hypothesis concerning the constancy of the Weber-Fechner relation in regard to perception of the length of pulsed tone signals in the 100-700 ms range.

The study describes the construction of a natural sound length scale involving application of direct and indirect scaling methods; it examines the analytical interrelationships between the form of the psychophysical function of the tone length perception and the method of analysis employed. The overall quantitative evaluation of the capacity for reflecting tonal lengths is presented as an aggregate of natural scales, of reflected stimulus values that under diverse experimental conditions pertained to sets of logarithmic, exponential or linear relations.

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The study substantiates this fact: The reflection of time-dependent characteristics in higher nervous activity depends on the mode of differentiation and evaluation of the signal length and is subject to various psychophysiological laws. The study discusses the problems in connection with the fact that the differentiation and the evaluation of the signal lengths are based on essentially different functional mechanisms of the human auditory system.

The selection of the time intervals required for the study presents certain difficulties. As is known from a number of studies (14, 28), there are some sufficiently clear-cut hypotheses concerning two basically different mechanisms of perception of short and long time intervals. Proceeding from a number of practical considerations (most of the signals used in technology are of short duration) and certain theoretical considerations (closeness to the intrinsic time of the cyclical processes of the central nervous system), in setting up the scales we decided on lengths between 50 and 700 ms, disregarding the characteristics of perception of very short impulses (where the Weber-Fechner law is known not to be operative) and of long time intervals (where the selection of the reading hours shows wide individual fluctuation).

The tasks set in the study are on the one hand of a generally theoretical nature and involve analyses of the psychophysiological characteristics of the human auditory analyzer; on the other hand, they assume the character of an applied science, of industrial psychology and ergonomics. Specification of the problems' applied-science aspect necessitates application of the methods of psychophysiology to the tasks of industrial psychology and projective ergonomics--the science concerned with the optimal, complex synthesis of the "man--machine--environment" systems.

In connection with the development of the scientific foundations of ergonomics, problems such as the psychophysiological correspondence of the "man--machine" systems are assuming special significance (21).

In order to be able to solve these problems, one must first of all know the optimal procedures for reflecting the parameter range of the "man--machine--environment" system (contemplated are procedures of information reflection) and thus ensure maximum productivity of the entire system with the lowest possible stress on the operators belonging to that system.

Inasmuch as the perception of information, the processing of the information received in the central nervous system, and the process of decision-making are the principal stages of the work process, it is also important to know the optimal variants of the information flow and some of the patterns of its representation in man's central nervous system.

We hope that the present work--which is dedicated to the study of the patterns of time reflection in human consciousness--will complement the presently existing pertinent concepts and that it will make it possible to use short time intervals as criteria for the selection, conditioning and physical diagnosis of the operators, for whom the time factor represents an element of their work process.

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#### VISUAL SIMULATION DEVICES FOR FLIGHT TRAINING SIMULATORS

Moscow IMITATORY VIZUAL'NOY OBSTANOVKI TRENAZHEROV LETATEL'NYKH APPARATOV  
in Russian 1978 signed to press 4 Oct 78 pp 2-4, 143

[Annotation, preface and table of contents from book "Visual Simulation Devices for Flight Training Simulators", by Valeriy Sergeyevich Babenko, Izdatel'stvo "Mashinostroyeniye", 1330 copies, 143 pages]

[Text] The basic principles for modeling the visual environment in flight training simulators are reviewed in the book. Theoretical substantiation is offered for visual environment simulators based on the principles of physical and mathematical modeling. Construction principles and the features and directions of development of visual environment simulators are set forth.

The book is intended for engineers and scientific workers. It may also be of use to students of the appropriate specialities.

#### Preface

In solving the numerous problems associated with the design and operation of aircraft and aircrew selection and training, and in research on optimizing the aircraft-pilot system and so forth, increasing use has been made recently of the modeling method, and various kinds of modeling devices and complexes are being created. In this an important part is played by the group of modeling devices with whose aid the main characteristics and processes of flying and flight control are recreated (with a certain degree of accuracy) on the ground. Flight trainers and simulators belong to this group.

Flight simulators, sometimes called modeling test benches, are designed for studying and optimizing aircraft characteristics and the characteristics of the equipment mounted in them during the process of design and production, and flight trainers are for training pilots in the skills of flying the aircraft in series production and operating the equipment in them. The use of simulators during aircraft design work and of flight trainers for pilots makes it possible:

1) to reduce the time taken for research (or training) as the result of working through processes at any stage of flight without having to carry out other stages, and to stop the flight at any moment and return to the initial situation and make operations independent of meteorological conditions and so forth;

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- 2) to enhance the effectiveness of research (or training) thanks to the more comprehensive working-through of flight processes in complex conditions with various kinds of malfunctions, even emergency situations, and as a result, to record and examine flight results more fully and objectively;
- 3) to make savings in design (or training) through the lower expenditure of fuel, less wear on and loss of parts, maintenance costs reduction, and so forth;
- 4) to reduce airport traffic involving test (or training) flights and release the aircraft and pilots used for these flights;
- 5) to improve research (or training) safety, lower the degree of environmental pollution with combustion products, reduce the noise level at projects and on the population living near airports, and so forth.

The use of flight simulators and trainers does not obviate the need for research and training flights, but already a considerable portion of flight training has been transferred to model systems. In the future, in connection with the development of new large and fast aircraft, and flights under complex weather conditions, together with the improvement of modeling devices, the role of flight simulators and trainers will grow even more.

Today's flight simulators and trainers consist of a great number of subsystems: simulators modeling the operation of various flight devices and the environmental effect, means of interaction between the tester (or flight instructor) and the modeling system and pilot, and so forth. One of the most important subsystems in a flight simulator or flight trainer is the visual environment simulator that models the external visual picture of the space visible to the pilot from the flight deck of an aircraft during flight. With the aid of the visual environment simulator, problems associated with visual flight in an aircraft can be solved in a flight simulator or trainer.

In this book we examine a broad range of questions connected with the theoretical substantiation and technical realization of visual environment simulators in flight simulators (or trainers). The first part of the book (the first and second chapters) is devoted to a postulation of the basic principles and theory in modeling the visual environment. In the second part (chapters three through five) design principles and the features of optical-mechanical, cinematographic and television visual environment simulators and visual environment simulators with electrical image synthesis based on essentially different technical principles, are examined. Particular attention is paid to visual environment modeling in a complete system with the aircraft trainer for pilots at the takeoff and landing phases. In principle, taking into account the goal-oriented purpose and initial, constraining and other conditions, the basic conclusions can be applied to other cases of visual environment modeling: in flight simulators, other kinds of flight trainers, set up for other aircrew members, and so forth.

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THE EXPLORATIONS AND DISCOVERIES OF THE PSYCHOLOGY OF CREATIVITY IN ARTIFICIAL INTELLIGENCE.

Moscow VOPROSY PSIKHOLOGII in Russian No 4, 1980 pp 171-173

[Review by V. A. Lyaudis of the book "Intelлект cheloveka i programma EVM" (Human Intelligence and the Computer Program) edited by O. K. Tikhomirov, Moscow, Izdatel'stvo "Nauka", Moscow, 1979, 230 pages]

[Text] It cannot be said that when computers first appeared in different areas of intellectual labor, psychology was ready to receive and adequately conceptualize this new phase in the history of development of the resources of human activity. The beginning of the era of cybernetics caught it unawares. At first, the science of human consciousness and the mind began speaking in a language hitherto atypical of it. It began to dismember the human mind into blocks, cycles, programs, and sub- and metaprograms. The more optimistic the forecasts of the investigators of artificial intelligence became, the more successfully this technomorphism rooted itself in the consciousness of psychologists.

But the shock produced by the first victories of cybernetics is passing. Computers have become a practical element of the daily occupational activities of tremendous masses of people. It is now time for psychology to think about the specific theoretical and methodological significance of this situation.

The information-cybernetic approach to the mind, which was the origin of both technomorphism in psychology itself and anthropomorphism and hegemonism in cybernetics, is becoming an object of serious criticism. But real solutions began to be found to these problems only when psychology joined the investigation of the structural and functional changes brought on in the system of man's intellectual activities and personal attitudes by the use of computers. The very possibility of such research was the result of theoretical advancement in the development of the principle of historicism in application to research on human activity.

That such advancement has occurred is evidenced by an entire series of collections published in recent years by a scientific collective headed by O. K. Tikhomirov. The most recent book, which contains the works of this collective and other researchers collaborating with it, provides persuasive evidence of the fact that psychology has reached an important level of theory--development of the general theory of personality function and development of mental processes in the presence of historically changing resources of cognitive activity.

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The key position of the author collective, which was laid at the basis of new methods and approaches to natural and artificial intelligence in psychological research, is declared with sufficient distinctness by O. K. Tikhomirov in the book's introduction and conclusion, and it is realized in all three of its parts more or less completely. This position is itself based on a sociohistoric interpretation of the new phase in development of man's cognitive and controlling activity, a phase which has given birth to the use of new technical devices.

Three premises substantially reveal the essence of this position, and offer a point of view opposite to the information-cybernetic interpretation of the possibilities of computers, and their role in human activity. The first premise asserts the need for arriving at a new object of investigation in the development and study of artificial intelligence. This object must be not the characteristics of artificial or natural intelligence itself, but the psychological characteristics of human intellectual function associated with computer use. Thinking generated by a new historic type of organization of human activity is precisely what should be the new object of psychological research. The book's foreword emphasizes: "Thinking mediated by computer programs is the most complex form of externally mediated verbal-logical thinking. Study of such thinking is the new task of general psychology, posed by automation of mental labor" (p 10).

The second premise substantiates the sociohistoric position of the authors in application to the development of special methods and procedures for studying the relationship between natural and artificial intelligence. Revelation and creation of mutual associations between natural and artificial intelligence in the course of man's purposeful activity made up the methodological foundation of each particular investigation of natural and artificial intelligence. This methodological starting point not only permits us to devise new methods of psychological study of dialog systems having the purpose of organizing cooperation between man and machine (and not their competition and rivalry), but it also has broad significance as well. It helps us to surmount a naturalistic interpretation of computer functions, according to which artificial intelligence is in direct opposition to natural human thinking, which leads to the conception of "autonomy" of artificial intelligence and "replaceability" of the functions of human intelligence. Computer functions are made absolute and universal in the naturalistic approach. A technical device is interpreted as an autonomous system existing in opposition to the cognitive possibilities of the human brain, defined in one way or another and, in the end, also made absolute. The logic of historic analysis makes the conception of autonomy and replaceability untenable, and it permits us to view the computer as a specific tool of purposeful human activity, as a resource called upon to make man's creative and communicative potentials objective, to materialize and amplify them, and not to subvert, constrict, and replace the functions of natural intelligence. Thus the idea that creation of a mutual relationship and cooperation between natural and artificial intelligence is a prerequisite for further development of purposeful activity and of man's specifically intellectual potentials was found to be the most productive in application to development of methods for studying dialog systems, as demonstrated in this book.

The position of the authors is also expressed consistently in the third premise, in which the historical approach is made concrete in application to the prospects

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for using computers in research on the mind, and in application to development of the potentials of artificial intelligence. Once again, in opposition to naturalistic tendencies, the book asserts the prospects for mutual enrichment of studies of natural and artificial intelligence. Development and improvement of computer programs cannot be the result of independent efforts by different engineering-cybernetic services. Every decisive step along this path is the product of the joint forward motion of psychologists, mathematicians, and cyberneticists in objectivization and mediation of the psychological components of human activity. Thus improvement of computer programs and the principles of their creation leads not to the pre-eminence of "superintelligence" but to revelation, objectivization, and enrichment of the possibilities for mental regulation of human activity, to fuller consideration of the functions of mental components in all forms of human behavior, in contrast to the tendency for neutralizing, for castrating the unique features of the human mind. The position taken by the book's authors in this issue is marked by maturity and thoughtfulness. The entire content of the book supports the premise that use and improvement of computer programs with a consideration for the unique features of human activity raises all research on human intelligence to a new theoretical level.

The prospects for development of artificial intelligence are also explored by the book in a particular fashion in this connection. The strategy of substituting man's real mental capabilities by the "superintelligence" of a computer is viewed as a most serious obstacle in the way of improving artificial intelligence, while the strategy of mutual association and cooperation between man and computer is viewed as the historically most justified and the most constructive and productive strategy.

It should be emphasized that this approach to the prospects for development of computer programs is just beginning to make headway today. The yearning to isolate and utilize the specific possibilities of both computers and human reason, and to seek the ways of their interaction has not yet gained universal recognition among the investigators of artificial intelligence. In the words of H. Dreyfuss, "most researchers can agree on nothing more than an independently operating intelligence."\* Thus the solutions posed by this collective work, which presents the programs and results of concrete studies on man's cooperation with computers in the solution of problems associated with cognitive and controlling activity, are all the more remarkable.

The premises examined above, which define the sociohistoric position of the authors in research on the relationship between artificial intelligence and human intelligence, are realized in psychological investigations of three central areas of practical automation of mental labor: use of computers in dialog mode, and creation of effective dialog systems; planning automated control systems and evaluating their effectiveness; development of the prospects for automating mental labor and creating artificial intelligence approximating human intelligence.

\* Dreyfus, Kh., "Chego ne mogut vychislitel'nyye mashiny" [Is There Nothing Computers Can't Do?], Moscow, Izd-vo Progress, 1978, 278 pages.

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Research aimed at developing the psychological fundamentals of dialog systems is described in the book fully and interestingly. The first two articles, written by O. K. Tikhomirov in collaboration with N. G. Belavina and Yu. D. Babayeva, describe a vast research program aimed at evaluating and improving dialog systems from the standpoint of a criterion which most significantly defines the creative component of human activity--the criterion of goal-setting. First of all the authors supplement and reorganize our understanding of the categories and phenomena associated with interaction between man and machine. The informational and technical criteria of interaction dynamics are in many ways predetermined by the psychological features inherent to the structure of interaction between an individual and a computer, the program of which mediates and materializes, one way or another, a particular context of communication with other people (the programmer, other users, the experimenter).

The authors suggest new interesting principles of organizing dialog between man and computer, viewing, as the dominate feature of their interaction, their mutual relationship, organized in a particular fashion, in solution of two types of problems--problems of thought and communication. They demonstrate the far-reaching influence of the factors of communication upon intellectual processes, and they distinguish new possibilities for controlling various aspects of the act of thinking in a dialog with a computer: through influence upon the goal-setting process, upon the rhythm of communication, and upon the form of relationships existing between man and the machine. Isolation of these three psychological variables, which can be regulated in the course of dialog with a computer, not only broadens the possibilities for controlling human intellectual activity, but also helps us to differentiate the entire area of study of specifically mental regulation of human activity, viewed not only in the context of man-machine dialog but also in other interaction contexts. Thus the rhythm of communication is treated as a unit of interaction analysis that is extremely important to solving the problems of optimizing any sort of activity.

Revealing the psychological variables of interaction, the authors offer a deep interpretation of a large number of specific phenomena arising in the course of man's dialog with a computer ("personification" of the machine, "partnership", "rivalry"). We cannot but agree with their premise that the tendency to personify a technical device, arising even among professional users of such devices, has its roots in the deepest properties of the human mind. Riding with this interpretation, the authors suggest not exorcising but exploiting this tendency for personification. They suggest exploiting man's motives of competition and emotional attitude, arising in the course of interaction with a machine, for the purposes of optimizing and "humanizing" the most heuristic programs.

In their analysis of the mutual relationship and unity of communicative and intellectual processes in dialog systems, the authors do not limit themselves to the simple alternative of either raising the machine's "intelligence" or raising the intellectual reserves of the individual. They point to a more-productive and realistic path. The creative potentials of an individual using a computer in his cognitive activity rise as the computer programs are "humanized" and as the computer "learns" to respond to various communicative influences, as the resources and procedures of controlling the intellectual and emotional spheres of the human personality broaden.

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In two articles devoted to the problems of communication and improvement of dialog systems, A. Ye. Voyskunskiy presents interesting evidence as to the role of psychological knowledge in development of the problems of artificial intelligence. He raises doubts concerning a number of premises that have already become axiomatic, particularly the premise of the meaningfulness of Turing's criterion to determining the intellectual possibilities of computers, and the premise that communication with a computer in natural language is the most promising direction in the development of dialog programs. These problems also give rise to questions that are more complex than they appear today, associated both with the need for further deep psychological study of human communication and with mutual penetration and synthesis of psychological and cybernetic research on communication.

It should be pointed out that all twelve articles in the collection are marked to one extent or another by the attributes of work on the frontiers of science. These articles are directed at seeking new paths leading to synthesis of isolated aspects of the realities under investigation. More than any other area of research, the effort to automate mental labor has revealed the importance and spurred on psychological investigation of a problem facing all modern culture--that of surmounting the separation of the intellectual and emotional spheres, of the conscious and unconscious, and of cognition and communication. On the whole the book leaves the impression that the search for methods for synthesizing all aspects of the complex realities of the human mind is successful and active, that we are successfully surmounting reductionism typical of those specifically psychological and cybernetic interpretations.

The sole disappointment of the book is that it does not have a subject index. The latter would have made it easier for the reader to evaluate and assimilate the diversity of new concepts and terms introduced and developed by the authors, and it would have helped him to immediately sense the refreshing breath of innovation in research on old problems and in suggestion of original problems, the breath of innovation borne by research at the point of contact of psychology with information theory in cybernetics.

On important merit of the book is that it is written without bias, with an effort to encourage debate. The book raises a debate with the positivist interpretation of the relationship between natural and artificial intelligence, with attempts at representing the laws of technical superintelligence as laws explaining human psychology.

The entire content of the book, which pursues the possibilities of thinking with the help of a computer--a new cultural and historic capability of the human mind, forces us to look in a new way at the subsequent fate of the debate on the question "Can a machine think?". Obviously before resolving this debate we would need to gain a deeper understanding of the nature of the phenomenon of man itself. The question as to what should be given preference in the next stage of evolutionary development of intelligence--human thinking or computer thought--cannot be answered apart from history, from the positions of naturalistic opposition of man and machine, apart from the logic behind development of human intelligence and its tools, within the context of changing systems of human activity and communication. I believe that the effort of the authors of this book provides full grounds for suggesting

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that we are fully prepared for the next step--a new level of theoretical generalizations that would significantly deepen our ideas about the nature of human intelligence.

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## MONOGRAPH EXAMINES THEORETICAL PROBLEMS OF HUMAN ADAPTATION

Novosibirsk SOVREMENNYYE ASPEKTY ADAPTATSII in Russian 1980 signed to press  
5 Mar 80 pp 2-9, 191

[Annotation, table of contents and introduction from book "Modern Aspects of Adaptation", by V.P. Kaznacheyev, Izdatel'stvo "Nauka", 3550 copies, 191 pages]

## [Text] Annotation

This monograph examines the theoretical problems of human adaptation, work on which is acquiring special urgency. Because new, previously uninhabited regions of the country are being developed and major industrial production complexes are being created in these regions, scientifically grounded recommendations on preserving and developing the health of the individual (the population) in different climatic, geographic, and production conditions are required. This work studies the mutual relationship existing between adaptation and pathological states. Some principles of diagnosing different human states are noted, and their significance to prenosological dispensary treatment of the entire population and to early disease prevention is analyzed. The basic directions of research on human adaptation to the Far North and Siberia are discussed.

The book is intended for biologists, physiologists, hygienists, and physicians.

Twenty-four tables, twenty-eight figures, five hundred forty bibliographic references.

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## Introduction

Development of our country's national economy and assimilation of new, vast territories, especially ones offering severe climatic and geographic conditions and characterized by specific, insufficiently studied bacteriological, viral, and parasitic infections encountered in natural foci, introduction of new production technologies, urbanization (of the North, the zone of the Baykal-Amur Rail Mainline, high mountains, and deserts) and other consequences of scientific-technical progress have significantly altered man's interaction with the environment. Evolved ecosystems, the psychophysiological properties of contemporary human population, and the structure and nature of diseases are undergoing transformation. Qualitative changes in biological and psychophysiological indicators of today's population are typified by development of new biological and general pathological laws, and by their specific orientation in particular climatic, geographic, social, and production conditions.

The social, production, and hygienic aspects of life-support systems are acquiring increasingly greater significance in the effectiveness of preventive measures. Works by A. L. Chizhevskiy and V. I. Vernadskiy on the biosphere, the noosphere, and the problems of regional and global ecology are very important from a practical point of view.

Analysis of public health in the country's eastern regions, some high-altitude regions, the arid zone, and marine environments would show that a significant proportion of the immigrant and indigenous population is under a state of chronic stress. Given the increasing manpower shortage, growth in labor productivity, and

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the faster rate of production and rhythm of life, one certain task is gaining priority significance--that of not only predicting arising of diseases and premature aging, but also preserving and developing the health of the present generation and guaranteeing the health of future generations.

Man and civilization, ethnic, biological, and psychophysiological laws, alteration of the environment, and the processes of technospherogenesis, noospherogenesis, and noocosmogenesis are becoming the most important problems of modern natural history not only because their study is revealing the increasingly greater potential of science in all areas, but also owing to their priority practical significance to society. The present scientific-technical revolution, transformation of historically evolved natural conditions over vast territories of the earth and its waters, and profound shifts in the biosphere have made the "Man and Environment" problem one of the urgent ones, and the mutual dependence of these processes on earth a problem of global scale. Its resolution is acquiring increasingly greater sociopolitical importance.

Among the issues associated with today's "Man and Environment" problem, adaptation, which has been the focus of a number of major international programs in recent years, is one of the fundamental issues. Many years of research on human adaptation to extreme conditions within the framework of the International Biological Program (1964-1974) have been completed. The results of research conducted by Soviet scientists have been published in the periodical literature and in a special monograph consisting of three volumes (Z. I. Barbashova, N. G. Rychkov, M. M. Mirrakhimov, N. N. Sirotinin, N. R. Deryapa, A. L. Matusov, F. F. Sultanov, N. P. Neverova, T. I. Andronova, N. N. Mikloshevskaya, I. I. Likhmitskaya, and others). Publication of the collective monographs "Obshchestvo i zdorov'ye cheloveka" [Society and Human Health] (1973) and "Filosofskie problemy teorii adaptatsii" [Philosophical Problems of Adaptation Theory] (1975), under the editorship of G. I. Tsaregorodtsev, was a major contribution to the problem's development. The theoretical and clinical issues have been illuminated in works by V. V. Parin, A. P. Avtsyn, G. M. Danishevskiy, A. M. Chernukh, F. Z. Meyerson, M. M. Mirrakhimov, A. D. Slonim, Z. I. Barbashova, I. S. Kandror, N. R. Deryapa, and L. Ye. Panin.

Four international symposiums on physiology and pathology of human adaptation to the North have been organized and held (Alaska--1967, Finland--1971, Canada--1974, USSR--1978). Works presented by Soviet scientists at these symposiums were given a highly favorable assessment.

Important fundamental and applied problems associated with studying human adaptation to the North were discussed at the Fourth International Symposium on Circumpolar Medicine (Novosibirsk, 1978).

The key laws governing the health, adaptation, and pathology of the individual cannot be correctly understood apart from the concepts of population and ecology. A biosocial being, man is still part of the biosphere, upon which he depends in view of the cycling of matter and energy, and which man is transforming with increasingly greater intensity (as a social being in this case), engaging in titanic biogeochemical work that has become the foundation of the noosphere's formation (Vernadskiy, V. I., 1977).

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The rate at which man develops habitats which are new to him and which satisfy the growing needs of society is rising constantly. Contemporary national economic development of the country's eastern and northern regions is a graphic example of this. The scale of anthropogenic changes being made in the environment in connection with man's economic activities is universally known (Fedorov, Ye. K., 1972; etc.). Such changes are important to biologists not only from the standpoint of environmental contamination or exhaustion of vitally important natural resources, but also as a process of active formation of a qualitatively new, more-complex environment, in relation to which man, as a biological species, does not possess inherited stereotypic adaptation mechanisms.

Modern human populations can no longer be viewed as conservatively stable groups constantly isolated, over several generations, in the places they have assimilated. Modern populations are better viewed as continuous flows of people migrating through geographic space in complex interaction with social, production, and natural conditions. The high migrational mobility of the population (Malinin, Ye. D., Ushakov, A. K., 1976; etc.) is becoming a regularly encountered phenomenon, characterizing one of the most important aspects of socially governed adaptation of modern populations. This unique feature is especially evident today in Siberia, the Far North, and the Far East--that is, in territories where the proportion of land developed by man is rising swiftly.

These circumstances--namely the high rate of the environment's modification, the constantly increasing mosaic heterogeneity of the biotic and physicochemical properties of the biosphere (especially in connection with urbanization, as well as agricultural industrialization), migrational mobility (long- and short-term) connected with industrial development of previously uninhabited regions, and intensification of man's own microevolutionary change--do not for practical purposes permit man to achieve any sort of stable relationship with the environment.

Using E. Bauer's terminology (1935), we can say that man's mutual relationships with the environment are typified today by an ever-increasing degree of stable imbalance, supported by constant adaptation.

One of today's scientific directions capable of accounting for all of these phenomena without ignoring processes and factors significant to human health, and of placing the accumulated knowledge in systematic order, is human ecology--that is, a new scientific direction extending significantly beyond the framework of demography, hygiene, medical geography, and so on.

The health of the individual and the population is a product of social anthropo-ecological interactions. It is becoming increasingly more obvious that we need to develop, in addition to the purely medical problems, directions associated with studying ecological laws, particularly human ecology--a new interdisciplinary direction studying the laws governing interaction of human populations with environmental factors, development of populations, maintenance and development of human health, and improvement of the physical and mental potentials of species *Homo sapiens*. In short, we need to reveal the laws governing interaction, with the environment, of large groups of people which, owing to common social, production, cultural, and biological bonds, are commonly called populations. We can already reveal such laws in relation to the populations of major territorial-industrial

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complexes in the Arctic, certain permanent settlements in the Arctic, stations in the Antarctic and other territories and, finally, the population of the European and Asian North as a whole. Despite the significant arbitrariness of such a distinction, this approach creates the possibility for studying the most general, fundamental laws governing preservation and development of health with a consideration for the unique features of all climatic, geographic, social, and production conditions. It should be emphasized that the concept of an individual's health and the concept of a population's health, though they are mutually associated and mutually dependent, pertain to different levels of society's organization. Thus individual health can be defined as the process of preserving and developing the individual's mental, physical, and biological functions and his optimum work efficiency and social activity in the course of a maximum (active) life span. Population health is a process of sociohistoric development of the psychophysiological and biological viability of a population, and of the continuity of generations in the face of an ever-increasing rate of social production and improvement of the population's stability as it develops new territories. It follows from these definitions that in addition to the criteria used to assess individual health, appropriate processing and generalization of which would provide important information on population health, we need to distinguish additional indicators reflecting the state of the population as a single whole. One of the most effective ways for developing such indicators might be to analyze the laws of human ecology.

It is precisely in the aspect of the laws of human ecology that we can understand, with greater depth and accuracy, the development of adaptive processes in the diversity of their manifestations within the individual and the population.

Analysis of human adaptation from the aspect of population ecology leads us to a definition of population health as a process of sociohistoric development of the viability (biological and psychosocial) of a group of people over a number of generations, growth in the efficiency and productivity of social labor, and improvement of the properties and characteristics of the species.

In addition to the individual properties of a population's individuals, the criteria describing the health of a given population of people include birth rate, health of offspring, genetic diversity, the population's degree of adaptation to climatic and geographic conditions, its readiness to perform diverse social roles, its age structure, and so on (Merkov, A. M., 1973; Bednyy, M. S., 1972; Uralnis, B. Ts., 1973; etc.).

Such are the basic modern aspects of human adaptation and human ecology, the scientific and practical significance of which would be difficult to overstate.

The work "Biosistema i adaptatsiya" [The Biosystem and Adaptation], in which I made theoretical generalizations and stated some premises concerning the problem's further study, was published in 1973. Since that time many issues presented in the book have enjoyed experimental and clinical development. The scientific subdivisions of the USSR Academy of Medical Sciences' Siberian Branch have accumulated new, original facts, and the research results have been published in scattered sources. Meanwhile the growing scientific attention to the problem and its practical significance to development of public health and the national economy argue for further work on the issues. It was not my task to illuminate all areas of the problem, the modern literature on which is enormous. This book basically contains

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facts acquired during expeditionary studies performed by scientists of the Institute of Clinical and Experimental Medicine of the USSR Academy of Medical Sciences' Siberian Branch. Some chapters illuminate issues that are presently debatable. This is natural, inasmuch as study of the problem as a whole, as was indicated above, began relatively recently. Meanwhile, development of the Far North, the eastern regions, and various extreme zones of our country, and urbanization are proceeding so intensively that we are constantly faced by more and more new problems.

Consequently unification and cooperation, clearer integrated planning of specific research, and better interaction with other problems having scientific and practical significance are becoming all the more necessary. I also feel that the new data presented here might have important practical significance to both organization of scientific research and the planning of the national economy.

Adaptation is without a doubt one of the fundamental qualities of living matter. It is inherent to all known forms of life, and it is so universal that it is often identified with the concept of life itself (Sel'ye, G., 1972). This is not accidental, since both the processes responsible for the origin of life, no matter where they proceed, and the evolution of life have always had adaptive properties. And being mandatory attributes of life, these properties become more complex in the course of life's development. They progress, acquiring an increasingly more active, sometimes overwhelming nature. And if we were to interpret evolution as progressive development of the properties of adaptation to the environment and of the properties of this environment's adaptation in behalf of living beings, then naturally the concept of life and the concept of adaptation would overlap significantly.

It is apparently no accident that the highly important concept of "normal health" is defined "...as the optimum state of a living system insuring *maximum* (italics mine--V. K.) *adaptation*" (Parin, V. V., 1973). In light of P. K. Anokhin's theory (1975) on anticipatory reflection of reality by living systems, and his conceptions on functional systems, notions as to the telenomic nature of vital activities and adaptation also come together. In the course of evolution of species and individuals, both functional-morphological mechanisms of adaptation to particular environmental conditions and new properties typical of the functional organization of internal and external adaptive processes were selected and reinforced, to promote further preferential survival of individuals, and preservation and development of the species (population). It is by these properties of adaptation and adaptive features, together with their concealed maximum potentials, that V. V. Parin's "normal health" of a living system is defined.

In the same way that properties of individual development are contained in the genetic apparatus and the qualities borne by genetic structures can be understood only when they are realized in individual life (in ontogenesis) so it is with the properties of adaptation and adaptive features--that is, the quality of life, the "normal health" of the individual may be deeply analyzed only when these properties manifest themselves in real life. For this purpose the given organism must be placed in natural or artificial conditions requiring maximum mobilization and exertion of its potential adaptive possibilities for survival and preservation. Thus the property of adaptation of a living system is essentially a measure of individual health. These properties can be evaluated and predicted both by extrapolation and by revealing some characteristics (labels) measured by conventional physiological

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tests. However, it should be stated that few sufficiently informative criteria are available yet, and the theory of long-range prediction of the health of living systems in extreme conditions is practically nonexistent, though important data have been obtained on the predictive role of certain factors--hypodynamia, change in biorhythms, hypoxia, nutritional imbalances, bacterial-viral and antigenic surroundings, psychoneural stress, the mutagenic background, and so on. The clinical aspects of adaptation, pathological process for example, have been studied much better (Avtsyn, A. P., 1972; Bayl', S. S., 1973), but their further development is being significantly restrained due to the lack of knowledge on the mechanisms of adaptation of healthy life in extreme conditions, and its reversible (prepathological) states (Parin, V. V., 1973).

Even greater difficulties arise in research on human adaptation in light of bio-social problems (Fedoseyev, P. K., 1976). It should be noted that by recognizing the future significance of social factors in assessment of man's biology, physiology, adaptation, and pathology (Dubinin, N. P., 1966), we impose special requirements on further research on adaptation not only in the social and hygienic aspects but also in light of the problems of the evolution, biology, and genetics of man, human populations, and the species *Homo sapiens* (Dubinin, N. P., 1977). As far as the latter is concerned, I would like to caution the reader against relatively unsubstantiated attempts at using data on the systemic organization, thermal dynamics, and evolution of some ecosystems in nature to interpret the state and evolution of human ecosystems, and attempts to find more similarities among biological, biosocial, and social systems without considering their qualitative differences. At the same time we should turn special attention to studying problems associated with evolution of the biosphere, the laws of which have hardly been explored by evolutionary biology (Dyubishchev, A. A., 1968). This is all the more important because the ever-increasing rate of evolution of the technosphere and noosphere has essentially embraced the entire surface of our planet, and near-earth space. Changing its environment, mankind must bear full responsibility for the future, which will be unimaginable apart from the laws of biology, psychophysiology, and other fundamentals of life.

The facts contained in this monograph are the author's generalization of the results of integrated scientific research conducted in the last 5 years by scientists of the Institute of Clinical and Experimental Medicine of the USSR Academy of Medical Sciences' Siberian Branch: L. Ye. Panin, V. Yu. Kulikov, V. V. Lyakhovich, M. A., Yakimenko, L. A. Kovalenko, M. M. Yegunova, Ts. P. Korolenko, V. I. Turchinskiy, and other institute colleagues. The author extends his gratefulness to them, as well as to I. A. Privalov, L. G. Matros, and D. N. Mayanskiy for their great help in preparing this monograph.

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PSYCHOLOGICAL CONDITIONS IN DISCOVERY BY THE PILOT OF CRITICAL INFLIGHT SITUATIONS

Moscow VOPROSY PSIKHOLOGII in Russian No 9, 1979 pp 114-117

[Article by A. A. Oboznov, Moscow]

[Text] Flying activity belongs in that kind of operator occupations for which the appearance of complex and critical situations is a not infrequent event. The most important condition for effectiveness of pilot action in such situations is timeliness of discovery by him of the complication being generated. Meanwhile, pilot practise indicates that many mistakes of a plane crew involve, precisely, an untimely exposure of a critical situation.

In the paper being presented we dwell on an analysis of a rather typical mistake of that kind involved in late discovery, by the pilot, of dangerous loss of height during withdrawal of the plane from a complicated situation, a mistake which can lead to the most serious consequences /3/, /7/.

We started out from the position that a psychological analysis of causes of untimely discovery, by the pilot, of dangerous loss of height--however this applies to an analysis of any mistake of an operator--should begin with an examination of the concrete content of the goals which face him /5/. If one accepts the assumption that an operator forms a concrete goal of action of control, in the form of a model of the future (given) status of the controlled model, then this model, in a functional sense, can be termed the model-goal /4/, and it can be assumed that it, precisely, determines the sequence and order of the operator's perception of signals about the status of the object being controlled.

In this connection, it is pertinent to note that--according to recommendations of some methodists of flight training--withdrawal of a plane from a complicated situation (CP), under conditions of horizontal flight, implies, above all, correction of deviations initiating on the gyro horizon indicator with respect to banking and pitching /2/. In such a method of training, withdrawal from CP is associated, by the pilot, with reaching

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definite magnitudes of bank and pitch which, as parameters of the object being controlled, have special subjective importance and occupy a central place in the model-goal. And this means that, in the process of withdrawal from the CP, the pilot will devote main attention to the on-going readings of the gyro horizon indicator and can omit looking at the height parameter. According to the hypothesis advanced by us, the timeliness of pilot discovery of a dangerous deflection of any sort in a flight parameter will depend on what kind of place this parameter occupies in the model-goal, or (which is the same thing), on the subjective importance of this parameter.

## PROCEDURE

The investigation was carried out in a pilot trainer which was a single-seat plane cabin with an instrument panel and control organs. The pilot was given the initial flight conditions, after achievement of which the instrument panel was covered with an opaque curtain. In a short time, by using the control box, the experimenter and his aide inserted, on the instruments, a complicated situation (the pilot could not see what kind of changes were put into the instrument indicators). Then the instrument panel was uncovered and the task of the pilot consisted of rapid withdrawal of the "plane," from the complicated situation, into horizontal flight. The character of the complicated situations and the order of their interchange were not known earlier by the pilot.

The experimentally-created complication was a change in the altitude reserve for withdrawal as compared with the altitude of the initial conditions.

In the course of the experiment, basic flight parameters were recorded on a film of an autographic apparatus; the controlling activity of the pilot; moments of radio exchange between pilot and experimenter (content of radio exchange was recorded in parallel on a tape recorder); marks of turning on or turning off the film equipment for recording the direction or the pilot's glance with respect to the instrument panel. Film recording of a glance was carried out with the help of an "NAC" apparatus. Speed of snapshots was equal to 8 frames per second. These film recordings were processed on an "M-220" computer.

Twenty-four pilots participated in the experiment carrying out, altogether, 312 experimental tasks.

## RESULTS AND DISCUSSION

Analysis of the recordings of pilot controlling movements showed that withdrawal from the complicated situation begins with elimination of the banking with subsequent levelling off of the plane with respect to pitching. The average time from uncovering of the curtain to the first controlling movement with respect to counteracting the banking and to the initial movement with respect to elimination of pitching, respectively,

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was equal to  $1.5 \pm 0.6$  sec and  $3.0 \pm 1.3$  sec.

It is understood that, in the time consumed in elimination of the deviation in banking and pitching, the altitude reserve was decreased, whereby, in 40% of all cases, the loss of height exceeded 1000 M, and, in 12.5%, 2000 M and more which--with a small reserve of time--can lead to the hazard of unsafe flight. These data once again point out the importance of timely stock-taking of the altitude for a safe withdrawal from the complicated situation.

What kind of attention is to be devoted--in the process of withdrawal--to the altimeter? For an answer to this question, let us examine the materials of film recording of the glance of the pilots (Tab. 1). This shows that the greatest attention in the process of withdrawal from a complicated situation was devoted to the gyro horizon indicator, a fix on the reading of which was taken in all cases without exception. For comparison, let us note that, even in those situations where the altimeter indicator was monitored, the percentage for it amounted to only 3.1% of the total time of monitoring of all the instruments, whereas fixes on the gyro horizon locator were longer by a factor of 26!

In a number of cases the testees reported reaching the tasked horizontal flight without ever having monitored the altimeter reading or even caring to estimate the height reserve actually at their disposal. Precisely in these conditions, the pilots were not always able to discover in time the dangerous height loss (set up by the experimenter) and continued to work the controls for 8-10 sec after the height was already equal to zero.

Thus, the ongoing magnitudes of bank and pitch are unfailingly monitored as of first order and basic by all the pilots during withdrawal from CS. This circumstance permits the view that the cited parameters occupy a central place in the content of the model-goal formed in the pilots; in other words, they are urgently important components of that model-goal. A parameter is viewed as urgently important when reaching a definite magnitude of it is directly required for resolution of the task, and for this reason the ongoing magnitude of the urgently important parameter is controlled, first of all. In this sense, the parameter of height in many of the situations studied by us can by no means be regarded as urgently important components of the model-goal.

Naturally, the height parameter always enters into the content of a model-goal of a pilot since for any pilot the need is evident for a definite height reserve during resolution of any concrete task; however, that parameter can have different subjective importance. In those cases where, in itself, maintenance of a certain height is not a direct requirement, though it is a condition for resolution of a task, the height parameter often becomes not an urgently, but potentially, important component of the model-goal. This means that the ongoing altimeter indicators are only "kept in mind" by the pilot and are monitored when there is a reserve of

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Table 1. Indices of Assembly of Pilot Information during Withdrawal from a Complicated Situation (Averaged Data)

Indices of structure of information assembly			
Instruments	no. of fixes in % of total no. of fixes	time of monitoring in % of total time of monitoring	mean duration of fix, in sec.
gyro horizon indicator	50.1	80.2	2.5
rate of climb indicator	22.8	9.3	0.5
velocity indicator	19.3	7.4	0.6
altimeter	7.8	3.1	0.5

Table 2. Number of Cases (Frequency) of Perception of the Altimeter in the Process of Withdrawal from a Complicated Situation

Type of experi- mental situation	Magnitude of initial height ( $H_{init}$ ) (M)	Reserve of height in a complicated situation ( $H_{res}$ ) (M)	Frequency of perception of altimeter (in % of total number of each situation)
A	1500	1500	86
B	1500	5500	86
C	5500	5500	73.5
D	5500	1500	72

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time, i.e., in second place. Whence it follows that timeliness of pilot discovery of a dangerous loss of altitude during withdrawal of a plane from CP depends on the sort of subjective importance the altitude parameter has as a component of the model-goal.

To clarify the factors which determine the different subjective importance of the height parameter, a special series of studies were carried out. Serving as controlled variables in the studies were the initial height ( $H_{init}$ ) and reserve of height in a complicated situation ( $H_{CS}$ ). Changing these variables, we created four types of experimental situations (Tab.2).

Serving as the initial condition, always, was a horizontal flight while the complicated situation was a descending spiral with a right or left banking of  $80^\circ$ . Situations in which  $H_{CP}$  amounted to 1500 M were conditionally termed critical, while situations with  $H_{CP} = 5500$  M were termed safe. (Footnote: The altitude was altered at the time of interjecting the complicated situation, i.e., it was hidden from the pilot).

Results of this series of experiments permitted the view that the subjective importance of the height parameter is a function not of the actually existing  $H_{CP}$  but, rather, of the magnitude of  $H_{init}$ .

First, the probability of monitoring the altimeter readings during withdrawal from a complicated situation is a function of  $H_{init}$  magnitudes (See Tab 2). If one compares, with each other, situations A and B or C and D, it appears that, with the same  $H_{init}$ , the altimeter is also monitored in the same number of cases, independent of the actually-existing height reserve for withdrawal. Conversely, in situations with a different  $H_{init}$ , the frequency of monitoring also appears to be different. Thus, in situation A ( $H_{init}=1500M$ ) as compared with situation C ( $H_{init}=5500M$ ), the altimeter is monitored 14% more often, although in both situations the height reserve for withdrawal was the same ( $H_{CP} = 5500M$ ).

Second, there is an analogous dependency demonstrated by the results characterizing the moment of first fixation of the glance on the altimeter after starting the withdrawal from the complicated situation. For example, in situations A and B wherein  $H_{init}$  is the same, the distribution of the moment of first fix on the altimeter is also practically the same although the height reserve in situation A was critical and less by almost a factor of four than in situation B. In addition, in the safe situation B, a fix on the altimeter occurs 2-3 sec earlier than in the critical situation D (Fig 1).

Thus, according to the data obtained, differences in importance of the height parameter are determined by the magnitude of  $H_{init}$ . This dependency can be interpreted from the point of view of the influence of a subjective adjustment on the evaluation of objective conditions of reality /1/, /6/. In this context, under adjustment is understood the preparedness of the pilot for selective perception and intelligent anticipation

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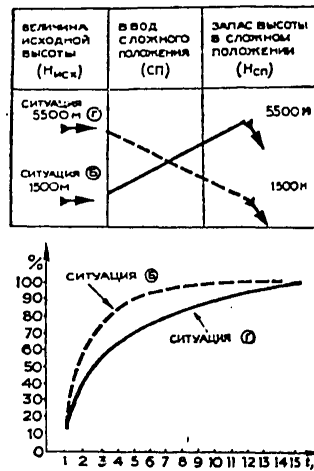


Fig. 1.

Integral function of distribution of time of  
the first visual fix on the altimeter at  
situations B and D

Key to Fig. 1:

- |                   |  |
|-------------------|--|
| 1. First column:  | Magnitude of initial height ( $H_{init}$ )<br>situation 5500 M (D)<br>situation 1500 M (B) |
| 2. Second column: | Introduction of a complicated situation (CP)   |
| 3. Third column:  | Reserve of height in the complicated situation ( $H_{сп}$ )                                |
| 4. Graph :        | Situation B<br>Situation D<br>Abscissa t, s  |

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of a complicated situation. In these situations, where  $H_{init}$  is not great, an adjustment for the worst is formed in the pilot, and his model-goal contains the altitude parameter as an urgently important component. In these cases, independently of the actually-existing  $H_{CP}$ , the ongoing indicators of altitude will be perceived as of first order items. Here, in the conflict between the adjustment for the worst and the safe withdrawal from the CP, adjustment by the pilot can take the upper hand.

Let us take the example of an incorrect assessment of a safe situation as the result of influence of adjustment for the worst. After completion of the initial conditions in situation B ( $H_{init} = 1500M$ ), pilot B. began withdrawal from the complicated situation, having a reserve altitude of 5500 M (see Fig.1). The very first (after removal of the curtain) fix of vision is upon the altimeter and only then does the pilot complete action to counter banking and pitching. After 6.1 sec from the start of withdrawal, there came the report "I am ejecting!", although at this moment  $H_{CP}$  was over 5000 M. In this same radio interval the following appeared. Since the initial altitude was not great, the pilot earlier had already adjusted himself for the worst. Precisely under the influence of the adjustment for the worst, there took place a mistaken assessment of the altimeter readings: figure 5 on the screen in the center of the altimeter, showing the number of total kilometers, was taken to be the number of hundreds of meters, hence the height reserve--instead of 5000 M--was figured as 500 M, i.e., less by a factor of 10.

In the presence of a sufficiently large  $H_{init}$  (situations C and D), an adjustment is created in the pilot for the subsequently positive withdrawal from the CP. In correspondence with this adjustment, a model-goal forms in him, in which the height parameter enters as a potentially important component. Hence, in withdrawal of the plane from the CP, the pilot first of all perceives the gyro compass locator readings, figuring that the existing reserve altitude configured in it is adequate and not losing time to figure out the altitude readings.

Under real conditions of flight, danger arises in those conditions where there is a contradiction between an adjustment for safe withdrawal and a minimal actual altitude reserve. Adjustment to a favorable outcome renders it harder for a pilot for timely recognition of an arising critical situation and thereby it hinders transfer of the altitude parameter from a potentially to an urgently important component of his model-goal. Whence, also, is created the impression that the pilot is forgetting about altitude although the psychological nature of this mistake is quite different.

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PSYCHOPHYSIOLOGICAL STUDIES OF OPERATOR PERFORMANCE AND EQUIPMENT USED

Moscow PSIKHOFIZIOLOGICHESKIYE ISSLEDOVANIYA DEYATEL'NOSTI CHELOVEKA-OPERATORA I IKH TEKHNIЧЕСКОYE OBESPECHENIYE in Russian 1979 signed to press 18 Jul 79 pp 2, 88-91

[Annotation and abstracts of articles from book "Psychophysiological Studies of Human Operator Performance and Technical Support Thereof", edited by V.G. Volkov, candidate of engineering sciences, chief editor, Izdatel'stvo "Nauka", 1900 copies, 92 pages]

[Text] This collection covers new methods and instruments for the study of psychophysiological parameters and characteristics of man as part of a semiautomatic control system, as well as the results of experiments conducted under various (including extreme) conditions.

It is intended for a wide circle of engineers, mathematicians and physiologists working in the field of applied human physiology.

Abstracts

"Dynamics of Operator Mistakes in Recognition of Visual Images," by M. V. Frolov, Ye. P. Sviridov and L. S. Khachatur'yants

This article discusses the results of experimental studies of recognition of visual images obscured by interference (Arabic digits 2-9, 0) in the course of prolonged (for many hours and many days) operator work. A difference was demonstrated in the dynamics of errors of different types ("skipping a signal," "false alarms," "confusion of signals") as fatigue progresses due to prolonged work and lack of feedback about the results of work, as well as a correlation between these dynamics and prior instructions, which form a subjective model of the experimental situation. A comparison is drawn between the physiological parameters of the operator's functional state while working to the parameters of the quality of his performance. Illustrations 3; bibliography lists 2 items.

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"Optimization of Methodological Approach to Simulation of Conflict Situations," by V. I. Kichkin

One of the possible methodological approaches to experimental modeling of a conflict situation is described, involving strict competition for the purpose of testing the effect on the latter of some psychophysiological parameters of competing ["antagonistic"] operators (time of sensorimotor reaction, attention, level of emotional excitement).

A potential variant is proposed of a device that permits simulation of a number of aspects of strict conflict that are of practical importance ("noisy," "blind," duel; duel with different exposure between "shots"; duel with addition of attention distributing task). Illustrations 1; bibliography lists 5 items.

"Autogenic Training as a Method for Stimulating Operator Efficiency," by Yu. F. Isaulov

This article submits data describing the influence of special autogenic [bio feedback] training on efficiency of an operator involved in various control systems and professional work. An evaluation is made of the efficacy of autogenic training to improve efficiency in the presence of different degrees of occupational fatigue. Illustrations 3; bibliography lists 6 items.

"Simulator for Pursuit Tracking With an Adjustable Pseudorandom Program for the Marker Trajectory," by V. G. Volkov

A method and device are described for conducting tests of two-coordinate pursuit tracking, the trajectory of the "pursued" marker simulating the movement of a tangible point in a viscous medium, which is submitted to impacts with other material particles. The trajectory of the marker on the visual display screen is determined by the direction and force of "collisions," which are governed by a random law, while its "mean" velocity is determined by the number of these "collisions" and depends on the quality of the subject's performance. Illustrations 1; bibliography lists 7 items.

"Some Results of Using Speech Parameters for Objective Diagnosis of Emotional Disorders," by N. A. Yerashchenko, A. Yu. Magalif and V. L. Taubkin

A study was made of the behavior of the parameters of flow of speech and acoustical characteristics of the voice of patients with manic-depressive

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psychosis, at different stages of illness. It was demonstrated that a number of speech parameters can be used for ongoing objective monitoring of the recovery process. Illustrations 1; bibliography lists 11 items.

"Physiological Distinctions of Psychological Models of Hypo- and Hyper-Gravity," by L. P. Grimak and N. N. Lebedeva

This article submits the results of a 10-day experiment with the use of psychological models of hyper- and hypo-gravity against the background of strict hypodynamia. According to the EKG, EEG, EMG, ERG and x-ray findings referable to the heart, a differential analysis was made of the functional changes in the body as related to the model formed. On the basis of this analysis, suggestions are formulated on curbing the adverse changes caused by the weightlessness factor in actual space flights. Illustrations 5; bibliography lists 6 items.

"A study of Man's Psychophysiological Characteristics Under Extreme Conditions," by N. F. Luk'yanova

The study of functional and psychological capabilities and personality distinctions of subjects makes it possible to predict the degree of their endurance in an experiment involving a stay on rescue [emergency] flotation devices. In the course of this experiment, a number of distinctions was demonstrated in the mental state of the subjects, with negative dynamics of the main mental processes (attention, thinking). Such experiments could serve as a model for psychological studies of people under real situations of this type. Illustrations 2; bibliography lists 6 items.

"Analysis of Mean Number of Intersections of Zero Level by a Physiological Process," by M. V. Frolov

This article discusses problems of estimating the mean number of zeros due to finiteness of analysis time and ignorance of the spectral form. Formulas are furnished, which permit evaluation, in particular, of the magnitude of a centroid according to mean number of intersections of zero level by the signal per unit time. Illustrations 1; bibliography lists 5 items.

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"Operator's Blepharomotor [Blink] Reaction During Intensive Visual Work on Detection and Tracking of Visual Signals," by Ye. P. Sviridov

This article discusses the frequency characteristics of the blepharomotor reaction (recorded by the contact method) in the course of many hours of operator work for detection and tracking of visual stimuli, which appear at random times. A specific "aftereffect volley" was discovered, which occurs after development of the goal, the frequency and duration of which change consistently in the course of many hours of work against the background of increased blepharomotor activity. The hypothesis is expounded that the parameters of this "volley" reflect the subjective complexity of the task to be performed. Illustrations 2.

"Study of Reserve of Operator's Visual Efficiency," by A. K. Yepishkin

This article describes the methods and results of stimulating a person in a state of extreme fatigue during a 3-day period of continuous work. It was demonstrated that purposeful stimulation enables the operator to mobilize his psychophysiological reserves and increases visual efficiency considerably. The experimental data make it possible to predict the quality of operator performance under extreme conditions, and they outline the ways and means of purposeful activation of visual efficiency when this is necessary. Illustrations 1; bibliography lists 13 items.

"Amplitude-Phase Discriminator With Display on a Two-Beam Oscillograph," by G. I. Nikitin

A description is offered of an amplitude-phase discriminator to single out spikes of concern to the researcher during extracellular recording of the activity of a neuronal population, with concurrent display on the screen of a two-beam oscillograph of the tested signal, bottom and top levels of the discriminator and output pulse of the discriminator. Structural and functional diagrams of the discriminator and display are provided. Illustrations 3; bibliography lists 42 items.

"Setting Standards for Psychophysiological Reactions of Working Pilots," by E. A. Kozlovskiy, V. F. Zhernavkov and F. A. Zubets

This article substantiates the desirability and feasibility of setting group standards to assess the level of a pilot's psychophysiological reactions. The studies established that individual differences and degree of reactions can be determined the most accurately by regression analysis of interrelations between the initial values of the psychophysiological parameter and its values during flight. The authors demonstrate

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that one can express the degree of nervous and emotional tension in a pilot as a score [in points]. Illustrations 1.

"Method for Generalized Evaluation of Quality of Operator Performance in Multidimensional Tracking," by E. A. Kozlovskiy and V. F. Zhernavkov

The authors propose a method for overall evaluation of the level of pilot training according to a single integral indicator of piloting error, which reflects mean error, dynamics and maximum deviations of each of the monitored flight parameters. The proposed approach can be used to assess the quality of performance and analyze the dynamics of training in any system of multidimensional sensorimotor tracking.

"Automated System for Microionophoretic Testing of Biologically Active Substances," by S. N. Kozhechkin, G. N. Bobrov and V. K. Kudryashov

The proposed system is intended for deliberate searchers of biologically active substances, development of new neurotropic drugs and the study of mechanisms of their action. The chemicals are delivered to a neuron by means of the microionophoretic method. The distinctive feature of this system is that the functional state of the target cell is stabilized. The frequency of neuronal generation of action potentials is held at a constant level, set by the operator, by means of delivering a chemical agent to the chemoreceptive membrane. The efficacy of the tested agent is assessed on the basis of change in magnitude of stabilizing effect. Measurements are made automatically with a calculator that implements multilevel stabilization of functional state of the neuron with display of a family of dose-effect curves. Illustrations 1; bibliography lists 5 items.

"Stimulating Effect of Autogenic [Biofeedback] Training on Speed of Information Processing," by Ye. A. Cherenkova

This article submits data on the rate of processing semantic information in the course of continuous operator work for 3 days. The use of autogenic training improved performance substantially. Illustrations 2; bibliography lists 3 items.

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"A Method for Statistical Analysis of Background Neuronal Activity With the Use of a Computer," by V. A. Zosimovskiy

A method is proposed for mathematical analysis of experimental data obtained from simultaneous recording of background activity of several neurons, which includes the following: 1) input in the computer of series of spikes of two neurons first isolated from a primary experimental tracing and each rerecorded on a separate track of magnetic tape in the form of series of formed impulses; 2) formation of series of times of appearance of spikes by means of the computer, and 3) statistical analysis of these time series, which includes plotting of distributions of inter-spike intervals of first order, histograms of auto- and cross-correlation. The processing programs were written in the FORTRAN IV language. The method was used with an YeS-1020 computer. Illustrations 2; bibliography lists 6 items.

"Attachment for Commercial Pulse Analyzers for Plotting Histograms of Slow Processes," by G. I. Nikitin

Structural and functional diagrams are submitted of attachments to a standard, high-speed pulse analyzer. Illustrations 1; bibliography lists 1 item.

"Graphic Recording of Galvanic Skin Response With Automatic Tracking of Tracing Level," by S. A. Varashkevich

This article demonstrates the advantages of recording a special class of electric signals by means of a device for automatic tracking of recording level (ASUZ). The basic diagram of the ASUZ device and analysis of modes of operation of different units are discussed on the example of recording the galvanic skin response signal. Illustrations 2.

"Operator's Oculomotor Reaction While Tracking Discrete Stimuli With Random Time and Space Distribution," by V. G. Volkov, N. N. Lebedeva and V. M. Mashkova

This article deals with development of a method and equipment it involves in the form of a specialized unit for testing the oculomotor reactions of an operator tracking discrete stimuli with random distribution in time and space. The results of an operational test of the method are submitted. Illustrations 4; bibliography lists 3 items.

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PSYCHOLOGY

RESOLUTION OF THE ALL-UNION CONFERENCE OF THE COUNCIL OF YOUNG SCIENTISTS AND SPECIALISTS OF THE USSR SOCIETY OF PSYCHOLOGISTS

Moscow VOPROSY PSIKHOLOGII in Russian No 2, 1980 p 185

[Text] On 10 December 1979 the Council of Young Scientists and Specialists of the USSR Society of Psychologists held its Second Conference in Obninsk. The following resolution was adopted:

1. Approve the organizational structure of the bureau of the Council of Young Scientists and Specialists of the USSR Society of Psychologists.
2. Approve the following composition of the bureau of the Council of Young Scientists and Specialists of the USSR Society of Psychologists (15 persons in all): N. Maksimova (Kiev), A. Karpov (Yaroslavl'), Ye. Shlyagina (Moscow), V. Barabanshchikov (Moscow), V. Ren'ge (Riga), I. Skotnikova (Moscow), M. Yegorova (Moscow), R. Sakvarelidze (Tbilisi), V. Semenov (Moscow), A. Asmolov (Moscow), T. Titarenko (Kiev), R. Gasparyan (Yerevan), Z. Bigvava (Tbilisi), A. Zhuravlev (Moscow), V. Gerbachevskiy (Leningrad).
3. Elect V. Semenov, scientist of the Scientific Research Institute of General and Pedagogical Psychology of the USSR Academy of Pedagogical Sciences, as chairman of the Council of Young Scientists and Specialists of the USSR Society of Psychologists; elect A. Asmolov, assistant of the department of general psychology of the school of psychology of Moscow State University and V. Barabanshchikov, scientist of the USSR Academy of Science Institute of Psychology, and assistant chairmen.
4. Approve the initiative of the councils of young scientists and specialists of the Georgian and Moscow branches of the USSR Society of Psychologists to hold joint scientific conferences devoted to the problems of the theory of activity and sets.
5. Hold a scientific-theoretical seminar on the topic "The Problems of Set" in Moscow in February 1981, and a scientific-theoretical seminar on the topic "Pressing Problems of Activity and Set" in Tbilisi in 1982. These seminars are to be sponsored by the bureau of the Council of Young Scientists and Specialists, and the councils of young scientists and specialists of the Georgian, Moscow, and Yaroslavl' branches of the USSR Society of Psychologists.
6. Hold a joint meeting of the councils of young scientists and specialists of the Armenian, Georgian, Azerbaijan, and Moscow branches of the USSR Society of Psychologists in October 1980 in Yerevan. This meeting is to be sponsored by the councils

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of young scientists and specialists of the Armenian and Georgian branches of the USSR Society of Psychologists.

7. Approve the report on the work of the Council of Young Scientists and Specialists of the Ukrainian branch of the USSR Society of Psychologists.

8. Approve the composition of the organizing committee and expert commissions of the Sixth All-Union Competition of the Works of Young Scientists in Psychology, "The Prospects for Development of Fundamental Directions of Soviet Psychology", dedicated to the 110th anniversary of V. I. Lenin's birth.

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PSYCHOLOGICAL RESEARCH BY P. J. SAFARIK UNIVERSITY IN KOSICE

Moscow VOPROSY PSIKHOLOGII in Russian No 4, 1980 pp 176-178

[Article by Yan Gvozdk, Kosice, Czechoslovakia]

[Text] The 14th CPCZ [Czechoslovak Communist Party] Congress laid special emphasis on the task of shaping the man of socialist society, a conscious creator of a new society. The 15th CPCZ Congress discussed the need for more effort on this task in the area of education, noting that in contrast to the traditional training system that has been in existence until now and which emphasizes verbal assimilation and mechanical reproduction of training material, the center of gravity of education in the schools must be shifted to systematic development of the activity and creativity of schoolchildren. The 11th Plenum of the CPCZ Central Committee emphasized the need for effective work in all areas of our life.

This is why we directed our research at developing the personality of the student. We shifted the center of gravity from personality diagnosis and consultation to creation of programs, techniques, forms, and strategies promoting personality development. Consequently we are undergoing a transition from individual work to methods that could be applied on a broad scale in the school, in extended-session school groups, in clubs, and in various hobby circles.

L. I. Brezhnev suggested the idea at the All-Union Teachers' Congress that it is not enough for students to simply recall information and knowledge; they must be taught to make independent creative use of this knowledge, and to acquire new knowledge independently. We believe that our work would be more effective if we orient ourselves on the problems of personality development, particularly on important qualities such as, for example, the individual's activity, his social orientation, and his conscious, creative approach to work.

This article will briefly illuminate some important results in the latest psychological research conducted at P. J. Safarik University in Kosice, mainly by the psychology department of the school of philosophy in Presov.

Most of the attention will be devoted in this article to analyzing the attained results, and the basic theoretical starting points and methodological principles of the research will only be touched upon briefly.



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The goal of our research is to find reserves with which to develop the students, and use them to create programs of development, mainly for under-achieving students.

The Basic Theoretical and Methodological Premises of the Research

The goal of our research is closely associated with an important contemporary direction of Soviet psychology and pedagogics, mainly with the works of V. V. Davydov, D. B. El'konin, and N. F. Talyzina developing the concept of developmental training; in the final analysis, our research is also closely associated with a pressing problem of modern psychological science--personality development.

As we know, these authors base their theory of developmental training on premises worked out by L. S. Vygotskiy (1970) concerning the psychological uniqueness of individual stages of mental development.

Experience shows that directed training may be used to optimize a student's development and create special programs having the goal of developing concrete mental functions. A child's development may be effectively supported by a system of conscious compensatory forms of activity--predominantly by so-called psychological exercises or training microsessions (Ya. Gvozdk, 1978). Use of these developmental programs is dictated mainly by their effectiveness in individual, differentiated pedagogical work with students and in the educational counseling system. These programs can also be used to reveal compensatory mechanisms that would improve the productivity of teaching students suffering retarded development of some mental function. The possibility arises for creating a program to improve motor functions, perception quality, attention, memory, and psychomotor rate, to reduce impulsiveness, to raise sensitivity, and so on. Naturally programs could be devised for optimizing social relations and nurturing social and emotional characteristics which would result in a positive orientation of the personality in relation to itself and its relationship to the surrounding world. I am referring to development of personality qualities such as the sense of trust, cheerfulness, self-confidence, curiosity, endurance, sociability, and self-discipline.

This work was based on our own research demonstrating existence of reserves for development of the minds of poor students, and the trainability of their creative thinking (Ya. Gvozdk, 1977; L. Klindova, 1978).

Of course it should be emphasized in this connection that work with the developmental program must proceed from a new standpoint accounting for the contemporary conception of personality development and formation, developing within the framework of Marxist psychology. This conception basically states that the human personality develops and forms through its own conscious activity, mediated by social conditions. It follows from the principle of the unity of the mind, consciousness and activity that the main resource for developing the student's personality is effective study itself. Therefore special programs will never replace education as the main and most effective way for developing all of a student's personality and capabilities.

Since the goal of developmental programs is to exert systematic influence upon the personality in order to develop a concrete mental function, such as self-regulation

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of mental activity, research being conducted in this area commonly follows a basic methodological pattern consisting of three basic phases: a) study of the existing state, b) influence upon the existing state, c) measurement of the effect of this influence.

The main plan of our research is based on the idea of controlling variables to such an extent that it would be possible to ascribe, with full certainty, an improvement to the observed variable: Preplanned interference is applied in the experimental group, while being absent from the control group. Effectiveness is measured as a rule by a set of certain criteria, and both groups of subjects are subjected to measurement before and after experimental interference.

Some Research Results, and Their Evaluation

Up to now, our research has proceeded in the following three areas:

1. Development of cognitive processes and the possibilities of cognitive development.
2. The motivation area, in the broadest sense of this word, emotional relationships, and emotional approaches with special emphasis on student regulation and self-regulation. We found from our previous research that development of this sphere of the student personality is an urgent necessity. The fact is that pedagogical practice in the school does not yet touch upon the internal world of the student's experiences. Little research has yet been done in this area, and pedagogical influences upon it are even less effective.
3. The area of socialization. Pedagogical practice shows that mutual relationships and cooperation among students are understated. As far as the first area of our research is concerned, we discovered important reserves for development of cognitive processes, and mainly some mental functions such as, for example, creative thinking, critical thinking, and so on. Our research showed that these reserves can be utilized by students from problem families, by under-achieving students, by students exhibiting low motivation for study, and in general by those who work is below their potential. In this regard, reserves were revealed in the training process itself. We tried to find out what sort of textbook problems or questions and answers provided by the teacher afford the students a possibility for working independently, actively, and creatively. We established that some textbooks (Slovak language and mathematics for fourth grade of primary school) contain few problems that develop creative independent activity of the students. In the Slovak language textbook, only 6.6 percent of the assignments can be said to develop creative, independent activity. There are very few such assignments in mathematics textbooks as well.

An analysis of the training process would show that the questions and assignments posed by the teacher do not develop creative thinking to the needed degree. We discovered that depending on the type of lesson, the teacher provides questions and assignments that would develop the creative independent activity of the students in only 4-5 percent of the cases. Most of the assignments and questions involved memorization and convergent thinking. One-third of the statements made by teachers were warnings and orders, aimed predominantly at maintaining discipline in the

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classroom; for the most part the assignments do not motivate the students to complete them.

On the other hand it was demonstrated that the reserves available in development of the creative thinking of students could be utilized to a much greater degree by creating new forms of activity which could intensify development of certain mental functions. We must distinguish those forms of activity which lead to positive interiorization, self-regulation, and development of the student's conscious relationship to himself and to society. Our research demonstrated the possibility for successfully applying programs for development of the creative independent activity and creative thinking of students, programs of language development for children from a pedagogically less-favorable environment, and training programs for children that are socially and emotionally unprepared for school. Students doing well in school also exhibited a positive response to such activity in comparison with a control group. Not only psychologists but also teachers and educators should make successful use of the program for development of creativity. This program contains 50 lessons, and it may be offered to students in the third through last grades of secondary school. Students demonstrated the most persuasive growth in originality of thinking, then in productivity of thinking, and finally in flexibility of thinking. The program for development of creative thinking also has the influence of improving attention; it raises the activity of the students in general.

The speech development program is intended mainly for children from a pedagogically unfavorable environment and enrolled in the senior nursery school group and in first and second grades of primary school. This program contains 50 lessons. It makes use of six testing and retesting techniques and 15 basic training exercises intended to develop the speech of the students (increase their word capacity and upgrade the quality of spontaneous verbal activity).

We also applied a training program for children that are socially and emotionally unprepared for school. We managed to either completely eliminate or restrict difficulties in adaptation experienced by children going from nursery school to primary school.

As far as the area of motivation is concerned, I should note that up to now, we have not had suitable techniques for revealing the motivations of students. This has significantly retarded the work on developmental programs. We devised a questionnaire with which to study motivation, and the methods for improving self-regulation of the students. Basing ourselves on the conceptions suggested by the Soviet authors V. Morgun and V. Aseyev, we are working on a program for increasing the scholastic motivation of students. We are developing, on the basis of P. Ya. Gal'perin's conception, a program intended to raise student attention. The motivation of weaker students is known to be lower, and therefore we are highly interested in studying the motivation structure of these students and discovering the areas in which motivation is weak.

We include analysis of school assignments from the standpoint of their motivational functions in this research area as well. We have developed a recording method that may be used to raise the scholastic activity of students. Use of this recording method showed that the experimental group improved its attention, it made

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use of divergent thinking more often, its activity increased, and its interest in the content of the assignments improved. The students can now draw from memory, and they have improved their knowledge and their mutual relationships with other children. Similar positive results were obtained in the program for raising attention and concentration.

In the third area, the area of student socialization, we are working on the problem of intensifying cooperation among students in their scholastic assignments. The results show that development of cooperation is basically associated with certain specific requirements that must be satisfied by the training material, and the concrete assignments and problems. Our work on this program is continuing.

Our research not only confirms the suggestion that there are reserves for mental development of students, but it also demonstrated the possibility for utilizing these reserves. This was persuasively confirmed in the area of cognitive functions and cognitive activity. Reliable results were also obtained in the development and use of programs having the purpose of developing the motivation of students, and their socialization. The present state of education in the schools does not yet offer sufficient possibilities for utilizing these reserves. Our research showed that neither the content of education in the schools nor the methods and forms of work presently employed are able to create adequate conditions for optimum, comprehensive development of the student's personality, and especially for development of his independent creativity, his independence, and his activity, and development of his thinking and critical outlook. In order to fill in this gap, we would need to further develop and use the forms of developmental training, developmental programs, and developmental counseling.

Our research is based directly on pedagogical practice. It shows the direction in which the content of education (in particular, that having to do with students and textbooks specifically) in the schools must be channeled and modified, it demonstrates how to improve the teacher-student system, and it reveals to us the sort of educational forms and methods we should use if we are to optimize and develop important aspects and properties of the personality, such as independence, activity, and independent creativity, satisfying the requirements of socialist society. We can hope that special developmental programs will play a significant role in this great struggle to impart a new countenance to the socialist school in our effort to modernize the pedagogical process.

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INTELLIGENCE TESTS IN PSYCHOLOGY

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[Article by K. M. Gurevich, Scientific Research Institute of General and Pedagogical Psychology, USSR Academy of Pedagogical Sciences]

[Text] The techniques of psychological diagnosis are used to study and compare mental development of individuals and groups selected on the basis of some significant characteristics. Major changes occurred in recent years in our understanding of the nature and laws of mental development. The need for considering the concrete historic nature of ontogenesis is being brought to the forefront today. The possibilities of mental development are being interpreted in a new way (3; 181).

Can the present problems of psychology be solved by techniques which had basically evolved back at the beginning of the century? Two questions arise: What aspects or properties of the mind must become the object of study and diagnosis and, correspondingly, what techniques should be prepared for this purpose? Will these techniques, tested by the traditional criteria of standardization, reliability, and validity, work in psychological diagnosis?

First of all we must see what traditional psychological diagnosis might offer in general for research on mental development. Intelligence tests that appeared on the scene in 1905-1911 in the works of Binet and his colleagues played the main role in this area. These tests constantly revealed low but stable correlations with scholastic aptitude in many European and North American samples of schoolchildren; in their modern versions, intelligence tests (Binet-Stanford, Wechsler, and so on) are distinguished by high reliability.

But the situation that has evolved in intelligence testing cannot be deemed satisfactory. Following long years of research, the very concept of intelligence is still fuzzy and theoretically confused. Cases of significant differences, constantly recurring in testing and invariably revealing themselves in tests of samples differing in nationality or educational, cultural, and economic status, have not been conclusively explained. There are psychologists who assert that these differences are elicited by differences in the intelligence of representatives of these groups. Others believe that the true cause lies not in differences in intelligence but rather in the nature of the tests and testing. The testers themselves admit that "Something is rotten in Denmark." As was indicated earlier, intelligence tests stand up well to the criteria of reliability and validity, which, according to the

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established point of view, should be in their favor, even despite contradictory evaluations of testing results. But can we remain satisfied with this?

The wide acceptance of testing in the West, the commercial interest of companies selling tests, and the certain social authority of tests hinder perception and sober evaluation of the present status of research in psychological diagnosis.

It should be noted that Soviet diagnostic psychologists do not find it possible, in the overwhelming majority of cases, to go along with the conceptions of Western testing. Our country is developing diagnostic techniques structured in such a way that they would be in line with modern viewpoints on the mind and its development.

However, while recognizing all of our achievements, we must admit that the soil in which Soviet psychological diagnosis is to form is still inadequately prepared. Critical remarks concerning traditional testing have never been systematized. We do not have a common position concerning the criteria used to evaluate the techniques--validity and reliability. The tools that have evolved in testing are not always employed competently. Some things are also still unclear in regard to social evaluations of tests.

The justification for the present article lies in the discussion above. It poses and discusses some problems of psychological diagnosis, particularly on the basis of intelligence test data. Intelligence tests have a right to be the primary center of attention: Great is their popularity, and far-reaching conclusions are sometimes made on the basis of intelligence testing results. It appears to me that discussion of intelligence tests would provide a possibility for also eliminating other problems of importance to all diagnostic techniques.

First of all it would pay to touch upon the terminology that has evolved in psychological diagnosis.

Psychological tests are usually used as a tool for testing people. In English, the word "test" itself means examination, or trial. But many different sides and properties of the mind can be tested. We do not need to waste time proving that the sides of the mind studied by the Rorschach technique are not at all the same as those studied by the psychophysiological techniques ("pressing a key in response to a signal"), or those studied by questionnaires ("Do your hands sweat in difficult situations?") or, finally, by those psychological sets of assignments in which the subject is asked, through clear instructions, to perform particular actions with certain materials, producing a particular sort of response at maximum speed.

Usually all forms of testing are referred to identically in books on testing--as tests (15), (13). Inasmuch as all of these forms of testing are psychologically different, it would have been proper to name them differently--we should have used the term test in the manner of Cattell (1890) and Binet (1895) in application to psychological assignments providing instructions that determine the subject's behavior, and all others should have been named psychological diagnostic techniques, attaching a label indicating the unique features inherent to each of them (psychophysiological, planning, and so on).

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A test is an examination, and the examinees enjoy different degrees of success: Some are able to solve only a few problems, while others manage to practically solve almost all. The number of correctly solved problems serves as a measure by which the examinee is evaluated, and in intelligence tests it is a measure of his intelligence. The obvious explanation here is that for one examinee the test problems are more difficult, while for another they are less so. Why?

According to the instructions of intelligence tests, the examinee must perform some logical actions. Should it be concluded that the difficulty encountered in taking a test and, on the other side of the coin, the success enjoyed in such a test depend on how well the examinee manages with the logical actions required by the test? We cannot agree with this conclusion.

Normal examinees who would be unable to correctly solve a single problem are extremely rare. Whenever they are encountered, the psychologist suspects that they had not listened to the instructions, or they simply did not wish to work according to the instructions. In the overwhelming majority of cases the examinee is able to solve at least some of the problems correctly. Can it be said of such a person that he is unable to perform logical actions? There are no grounds for this; by solving even three or four of the problems, the examinee demonstrates that he is capable of logical actions. The cause of his failure must be sought elsewhere.

And in fact, many works have appeared analyzing the various causes that reduce the successfulness of the examinees. The culture factor is given the greatest significance today.

We must obviously begin with the testing conditions. Both individual and group testing is structured in the form of a lesson. The psychologist performing the experiment plays the role of teacher, and the examinees play the role of students. The psychologist begins by offering short and clear instructions, communicating the nature of the work, the way it is to be done, and the signals that would indicate the beginning and end of testing. The psychologist prepares the examinees for action, analyzing examples with them and answering their questions. All of this very much recalls ordinary classroom activity. In general, testing reproduces the order of the European and North American school. This order is well familiar to the bulk of children and adults, who have no need for special adaptation to it. But when working with subjects who had received their education (if they had received it) in schools of a different type, or subjects who had a short school career or had left school long ago, this testing procedure would be uncomfortable and unusual, and it would invariably have an unfavorable influence upon the testing results. But this is not all. Children who have gone to school for the same number of years may also evaluate testing conditions differently. Some are certain that they will pass these examinations as well as many others they had taken previously. Others are sure that they will once again fail. Any such test will cause discomfort in the latter, discomfort from which they will hasten to extricate themselves.

Researchers have established that children of a low socioeconomic level take tests hurriedly, they select their responses randomly, without thinking, and they finish their work before the allotted time runs out. Such reactions were observed, in particular, in the USA during testing of Puerto Rican schoolchildren (13; 345-346).

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In the opinion of the researchers this sort of work reflects both a lack of interest of the subjects in abstract assignments, and their certainty that they should not expect to do well. Understandably, the results are poor. But what is important is that the psychologist does not have the right to declare that he is "indifferent" as to why a subject did so poorly in a test. The same consequence brought about by different causes requires a different attitude and evaluation.

But the main influence of culture, we can suggest, reveals itself in something other than the testing conditions. As time goes by, we are gradually beginning to realize the exceptional role played by the content of the problems or, more accurately, the role played by material through which the problem is presented: In tests, problems are given either in verbal form, or in graphic form--as geometric figures, illustrations, and so on. The significance of accounting for this material in the subject's final evaluation is very high.

B. Simon, a well known English educator, noted that tests given to English children contained words which far from all of them knew (Simon's book was published in the early 1950's). Such words included "counterfeit", "antique", "extrinsic", and "irregular". Simon believes that some children did not know what these words meant. A child taking a test "must know the function of telegraph in distinction from the telephone, ...why money accumulates, the goals pursued by benevolent societies, and so on. Many workers' children will not even ever hear about such things, and, moreover, they cannot answer these questions until the meaning of each word is understood completely" (10; 47-48).

This passage refers to two close but, nevertheless, incompatible features of word understanding. The child would be unable to solve a problem if the words contained in this problem are unknown to him. But this passage also implies that test questions cannot be answered "until the meaning of each word is understood completely". Word understanding should be defined in this context as the subject's grasp of the set of semantic associations this word has with other words of the given language assimilated by the subject. In general, the associations of a word with other words are diverse, and sometimes innumerable; they include associative links reinforced through oral communication, and logical-functional relationships revealing mutual dependencies: genus-species, part-whole, membership to one or several logical classes, analogy, opposition, identity, and so on. Assimilation of these associations occurs in ontogenesis, inasmuch as they are fixed within the language system of the social society within which the given person lives; he masters them in the course of his objective activity. But owing to national, class, and historical restrictions, not one social community has mastery over the entire wealth of its language, or all of its interverbal (and interconceptional) association.

Therefore it is always easy to find differences in the word composition of languages spoken by different social communities, and differences in the associations established between words within a particular language system. Here is a simple illustration: The word "class" may be encountered in different professional groups--in the speech of a schoolteacher, a historian-philosopher, and a natural historian-biologist. But all of these specialists would rely upon different associations in their understanding of this word: The teacher understands the word "class" in association with the word "students", "teacher", "lessons", "school", and so on. For the historian, the dominate associations would reveal themselves in the mainstream

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of historical and economic thought: antagonistic classes, the withering away of classes under socialism, and so on; for the biologist, the concept "class" is associated with the grouping of taxonomic orders or animals or taxonomic orders of plants. It may be possible that these specialists are not ignorant of the associative and logical-functional associations behind this word in other professional lexicons, but when communicated on a relatively neutral background, the word "class" would more readily, and in a greater number of cases, recall those associations which had evolved in the given specialist's mind.

Such associative and logical-functional features of the associations represented by words can be revealed much more clearly in stable social communities that have developed over a long period of history--nations and nation states. In one study more than half of the Americans participating in the experiment responded to the word "eagle" with the word "bird". Kazakhs, meanwhile, gave that answer in only a small number of cases (14 percent), while more than 60 percent of their responses consisted of words such as "golden eagle", "fox", and "rabbit". The golden eagle is a traditional helper of the Kazakhs when hunting for these animals. (4; 82).

The culture concept is usually brought up to explain such differences in the associative-logical background of a word. Americans establish certain associations between words, while Kazakhs establish others, and this can easily be explained by differences in the national culture of the peoples. Today, when such differences are discovered in testing studies, the uniqueness of national cultures is what is usually cited at the explanation. This uniqueness is also used to explain the poor performance--in comparison with the performance of the white majority--in intelligence tests observed in American national minorities--Negroes, Mexicans, and so on. The same sort of differences are also noted in comparisons of the contemporary spiritual and material life of European and African peoples. In this case the differences are so pronounced that no specialist could doubt their existence.

However, can we limit ourselves to recognizing national differences without noting the differences existing among social communities within a particular nation? We cannot deny that nations make a certain impression upon their members, but within each nation there are social classes, and membership to particular classes also makes a distinct impression. In 1913 V. I. Lenin wrote: "There are two nations in every modern nation--this we say to all national-socialists. There are two national cultures in every national culture" (1; 129). Within the framework of each of these cultures, we can find cultures representing lesser social communities--they may be referred to as subcultures, or cultures of particular social and occupational groups. To be clearly understood, let me say that the words "culture" and "subculture" signify not different levels of "education and upbringing"--another interpretation that has taken its rightful place in the language, but an integral characteristic of the psychosocial and economic conditions of material and spiritual life having a direct and indirect influence upon the mind and activity of the individual, and upon formation of his individuality and personality.

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Sociologists and philosophers recognize the difficulty of giving a scientific definition to the concept of culture. Let us use the wording suggested by V. M. Mezhuiev: "Culture represents the individual's functional-practical unity with nature and society, a particular means of his naturally and socially determined functional existence" (6; 101). The broadness of this definition elicits a positive relationship; it permits inclusion, within the culture concept, of the historically changing factors of human life, and it implies that man and his activity are not only determined by culture, but they are also a motive force of its development.

Culture is one of the most all-embracing characteristics of the state of productive forces and production relations; thus it follows a historic pattern, and within every national culture, given all of its diversity, we can always reveal a phase of forward progress of human history. Membership to a particular culture forms, sometimes without directed effort on its part, the unique features of the subject's mental and verbal activity, and creates the algorithms of his mental development. But it also imposes restrictions on the mind's development, particularly on the range and orientation of the assimilated associations between words. These restrictions will gradually disappear as the walls between social communities disappear. (Culture makes its impression not only on mental-verbal activity but also on the personality as a whole; however, these issues are outside the topic of this article.)

Serious testers assert that no test is perceived identically by people of different cultures: "No test could be universal in its use, or equally 'valid' in relation to all cultures" (13; 345):

It would be entirely unsatisfactory to correct the problem of intercultural differences in testing by "lowering" the norms for some subjects or "raising" them for others, depending on the culture to which they belong. In this case membership to one culture differing from that embodied within a given test is interpreted as membership to a lower level of that culture, with which we cannot at all agree, since the uniqueness of the subject's own culture is simply ignored.

Recognizing this, we should also recognize that the author of the test unavoidably introduces, into the test he is preparing, into the material that he places within it, his own knowledge, his own algorithms of logical actions, and his own culture. In the particular social conditions of the antagonistic classes of Western society, the test represents the culture of the ruling classes, and thus it is no surprise that a subject from one of the exploited classes usually cannot relate to it.

A. R. Luriya's book (5) provides a unique basis for discussing these problems. The study described in the book was performed in 1931-1932 in remote regions of Uzbekistan. The subjects were illiterate or barely literate farmers, some of whom had already entered into social life, and others of whom had a first or second grade education.

Although this study can in no way be referred to as a test, the material offered to the subjects corresponded completely to the problems of intelligence tests. In this case the psychologists paid no attention to what testers are usually interested in--the individual features of the subjects. Moreover the method of study did not

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correspond with testing either. "The experiments were performed in unrestrained surroundings--usually in a tea room, following a long talk over tea, in the form of a 'game' with an accompanying interview. Sometimes the experiments were performed concurrently on two or three subjects, who attentively examined the illustrations presented to them, interrupted one another, and suggested their own solutions" (51).

The value of the psychological experiment described in this book is that it examines not only the responses of the subjects but also the considerations that encouraged them to provide such responses. A tester usually qualifies the responses of his subjects by means of a few labels--right, partially right, and wrong, but he is deprived of the possibility for expanding on the mental-verbal activity at the basis of the response. The subjects of these experiments freely discussed their responses, sticking to or rejecting their decisions. It was amazing how seriously and thoughtfully the subjects prepared their responses, and how consistently they defended them.

They had complete respect for the psychologist performing the experiment. But his attempts at encouraging them to reconsider their responses were not always successful. In the course of discussion, the subjects replied with their own arguments, using them to prove the correctness of their responses. Meanwhile the psychologist who had prepared the experimental material found neither their responses nor the arguments they raised in support of the latter to be unconditionally right.

We will limit ourselves to examination of only a few of the experiments in which the subjects were given generalization problems. Four illustrations were presented. The objects represented in these illustrations had to be classified: By the psychologist's intent, three had something in common, and the fourth stood apart from them. The material was thought out meticulously: "Objects to be classified were selected in such a way that they could be combined on the basis of two principles--either their membership in a single logical category, or their membership in a single practical situation. This condition was satisfied, as an example, by the group: hammer-saw-log-axe. Were we to combine these objects according to the "implement" or "tool" characteristic, the log would not fit with the rest, while were we to combine them on the basis of a practical situation, the hammer would not fit. Subjects performing this classification had to verbally describe the group into which the three objects fit. If for some reason the psychologist was dissatisfied with the response, he suggested his own version: "Another person solved the problem differently, he placed such-and-such objects into one group." "Analyzing his own solution to the problem and another possible, hypothetical solution suggested by 'the other person', the subject permitted us," the author writes, "to penetrate more deeply into the psychological processes underlying his mental operations..." (page 60).

The psychologist made a special effort to prepare images of objects that were well known to the subjects from their day-to-day experience. It was this that predetermined the most interesting results of the experiments. As it turned out, the subjects employed neither the first nor the second principle conceived by the psychologist, instead suggesting a third principle which can be conditionally referred to as "Robinson's principle" (this term is not used in the book). This

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is a principle of immediate necessity. It obviously played an important role in the living conditions of the subjects.

The subject is offered certain objects (illustrations): hammer, saw, log, spade. The subject offers the following solution: "They are all similar. I think they are all things I need. If I were to saw something, I would need a saw, and break up soil, I would need a spade.... See, I would need everything!" The psychologist tries to explain the test with another example which seems simpler to him: "Here, as another example, you see three adults and one child; clearly the latter does not fit." But this solution does not meet the support of the subject: "But they need the boy! Look, all three are working, and if they had to constantly keep leaving to fetch something, they would never get any work done; the boy could fetch things--he would be learning something, and this would be better, since all would be able to work well" (page 69). And subsequently, as soon as the subject reveals the principle of immediate necessity, he responds in accordance with this principle, no matter what sort of "arguments" the psychologist suggests.

In one of the experiments the psychologist asked his subjects: "What three objects would you have to pick up if I asked you to pick up all that could be named by the same word?" (he had the word "tool" in mind). One of the subjects--there were three of them this time--replied: "It seems to me that a log is also a tool, because tools could be made from pieces of it as well." The psychologist cited his "other person" who felt that the log was not a tool.. The subjects would not give in: "No, only a crazy person could have said that" (page 74).

The mutual disagreement may be explained by the fact that the psychologists, in asking the subjects to classify objects on the basis of the category characteristic--tools, household objects, and so on--hoped that the subjects would make their generalization independently of the particular characteristics of these objects that would make them necessary in the situations in which they are used. The psychologist presumed that the subjects would understand that a generalization may be made apart from a practical situation. But to the subjects, performance of the theoretical action of generalization was possible only in the context of a practical (be it even imagined) situation. Consequently the truth is not that the subjects do not know how to generalize, but that their acts of generalization are always based on the principle of immediate necessity, and only "a crazy person" could ignore this principle. Perhaps any classification characteristic would have been entirely acceptable to the subject, if its presence were necessary in a practical situation.

In any case we cannot reject the fact that the subjects are entirely capable of the act itself of logical generalization. But the logical-functional associations offered to them are incompatible with their culture. Can they establish other logical-functional associations? The book confirms that they certainly can.

Differences in mental development manifest themselves most distinctly not in the fact that some persons, for example representatives of the urban intelligentsia, are capable of making generalizations while others, for example representatives of rural areas suffering retarded economic development, are incapable. The differences manifest themselves in the sort of logical-functional associations upon which

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communication is based, in the sort of associations at the basis of the mental search for the characteristics used in generalization. Some people have accumulated sizeable experience in making generalizations on the basis of any characteristics, no matter how divorced from the immediate situation, while others have been "programmed" by their way of life to seek characteristics which would permit them to combine different objects on the basis of their immediate necessity. This is also a generalization, and it may not be any simpler than generalization according to the category principle. Generalization on the basis of the principle of immediate necessity is, first of all, an indication of a practical mind-- "...practical activity 'always has to do with the particular', and in it, human intelligence encounters a special task: application of universal knowledge to particular cases. This task is completed by the 'practical mind'," wrote B. M. Teplov (12; 255).

In the experiments described in A. R. Luriya's book, the subjects were shown objects known to be familiar to them. The insurmountable difficulty which B. Simon noted did not arise in these experiments--the subjects did not encounter something with which they were unfamiliar. Nevertheless the objects offered to them in the experiments were understood by them in contents entirely different from those that seemed obvious to the psychologist. Had this been a test, rather than a study involving special tasks, the subjects would naturally have received the lowest possible scores. But what in fact do test scores tell the psychologist? Only that the test compared two different cultures, and no conclusions on intelligence could be made on the basis of such a comparison, since such conclusions would be absurd and unscientific. Obviously the psychologist must also consider this in cases where the gap between cultures, the historical distance between them is not so great; in such situations the differences would not reveal themselves so distinctly. But no matter what the differences are, they could be interpreted in accordance with their psychological nature--that is, as differences between the cultures of the social communities the subjects represent. As will be shown below, this fact opens up new perspectives for tests.

Consequently intelligence tests reveal how close the subject is to the culture upon which the test is oriented; owing to this function, tests have naturally become a necessary tool in the social system of the West. The previous discussion demonstrated that the capability of the subjects for performing logical actions does not play any special role in these tests, and it may even be that it does not play any role at all. It would then have to be presumed that the subject's affinity to the culture represented in the test could also be evaluated on the basis of some other characteristics, not just his capability for performing logical actions. As an example it could be evaluated on the basis of the subject's acquaintance with words, concepts, and opinions regularly encountered in communication in the social community having the given culture. After all, such acquaintance is not based on a capability for performing logical actions; memory has little to do with it (we ignore memory pathology in this case); it is an attribute of the mind, invested into the latter by the subject's way of life without any special effort on the part of the subject.

The authors of the most widespread intelligence tests adhere to precisely this point of view. Here is an incomplete list of questions of this sort in the Wechsler Adult Intelligence Scale: The subject must state the colors of the

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American flag, the shape of a ball, the number of months in a year, what a thermometer is, who the famous Longfellow was (a poet, a musician, or something else), how far it is from Paris to New York, the population of the USA, the number of senators in the U.S. Senate, the three types of blood vessels in the human body, and so on (18; 33-35).

A person answering these questions (or some of them) would thus demonstrate how close he is to the culture dominating in the social community, within which he will have to display his educational or job suitability. Acquaintance with these terms is a phenomenon of entirely the same order as logical actions in the suggested group of words. In the foreword to his tests, Wechsler presents some of the correlations he obtained. Interesting in this case are the coefficients of correlation between assignments gauging the extent to which the subject is informed, and the rest of the verbal series. The coefficient is 0.89 for subjects 17-18 years old, it is the same for older age groups, and for the 40-54 year group it is even as high as 0.90. One is forced to think that responses to questions gauging the degree to which the subjects are informed could fully replace the entire scale.

It would be meaningless to seek a rule followed in selecting questions devised to gauge the degree to which subjects are informed, or material used in intelligence test problems. The entire matter lies with the psychological intuition of the test's author. The literature on testing does not commonly explain why the author chose these and not other words, illustrations, and questions for his test. An ironic remark by well-known testers would be pertinent here: "Writing good test problems is an art. To some extent it recalls writing a good sonnet and baking a good cake. The actions are not as free and whimsical as with the writing of a sonnet, and they are not as regimented as with baking a cake. They are somewhere in the middle" (17; 60). What is meant by this is that the author of a test intuitively selects the material, relying on his own experience as a practical psychologist. Selecting the questions, the author has in mind a model of an "average" person useful to his social community: The questions represent the "average" mental composition of such a person.

Such a model is not universal; it is not compatible with all representatives of the social and national groups in the given community, all of which have their own subcultures; more likely this is not even a model of the average, but rather the most frequently encountered variant. Complete agreement of scores based on tests and scores based on career successfulness does not in fact occur, but correlation coefficients on the order of 0.40-0.50 are observed within the framework of a given social community. The intuitive approach obviously leaves little more to hope for. This is the usual degree of compatibility between intelligence test characteristics and the subject's background characteristics.

The discussion thus leads us face-to-face with the question as to what is defined as intelligence in testing. Let me make the qualification that the reference here is to test intelligence, and not wisdom; test intelligence is not equivalent to wisdom. Test intelligence is the capacity or ability to perform prescribed logical actions with material representative of the social community upon which the test is oriented; it is the ability or capacity to find prescribed logical-functional relationships between certain objects common to the given social community. There is no reference here to the degree to which a subject is informed at least because assignments measuring this attribute cannot be called tests.

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Moreover we must keep in mind that test intelligence is "speed" intelligence. The overwhelming majority of intelligence tests, and other tests as well, are timed tests. No matter how well and accurately he works, a subject who works slowly will always lose out. It is taken as a self-evident truth in testing that fast thinking is of great social value. What, then, can we say about the slow thinking typical of Einstein, or the greatest mathematicians of the 20th century, N. N. Luzin and D. Gilbert? It would not be difficult to answer this question. Testers who insist upon the great significance of thinking speed probably base their model on the ordinary, and not the outstanding, individual. People characterized by high thinking speed are more useful. But the psychologist should consider that swift-ness in testing is an ambiguous parameter. The pace of any work, including that associated with testing, depends not only on the subject's natural pace but also on the extent to which the actions being performed are automatic. Therefore every sample may contain subjects completing, as an example, a third of the problems; but one might have finished only that many because he works slowly, while another might simply be unaccustomed to working with the given material, even though he could generally be classified as a "fast" worker. Only a person who knows little of psychology would treat both subjects as being of equal intelligence, even test intelligence.

It would be impossible to embrace all questions associated with intelligence testing within a single article. What is the future of testing? How should intelligence tests be used in the development of psychological diagnosis? First of all the true nature of these tests should be revealed. That which they do test is important and necessary, but the word "intelligence" has extremely arbitrary meaning in the names of these tests. What these tests do study is the extent to which the individual is a part of the culture upon which the test is oriented. The ability to establish logical-functional relationships of particular content--today's tests have demonstrated in their camouflaged form--is a very important ability, one needed in school and on the job. But between which words must the subject know how to establish associations, and precisely what sort of associations should he establish? The answer to this question would probably require a significant amount of research by a team of scientists working together--a psychologist, a linguist, and an educator. Such research would have to define, by way of psychological-linguistic analysis, the range of words, concepts, and objects that should be assimilated at a given stage of ontogenesis. Next it would have to establish the sort of logical-functional relationship that the developing individual must know how to establish between them. This material is what would make up the basis of the intelligence tests or, more correctly, the tests of mental development adequate to the given culture. By testing students, we should establish whether or not they have facility with the arsenal of words, concepts, and so on, and with the system of logical-functional relationships between them, that would serve as the basis for their cultural and psychological development. Testing different samples of students, the psychologist and the educator get a possibility for objectively comparing these samples on the basis of the described characteristics. Concurrently, tests would help eliminate omissions and errors discovered in the development of the children. Within known limitations, this information may also apply to individual students.

It appears to me that objective-cultural psychological tests in mathematics, linguistics, physics, and so on enjoy considerable room for development. I am not referring to aptitude tests. Tests developed with a consideration for special requirements

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imposed by these and other areas of knowledge upon mastery of logical-functional relationships typical of them would permit us to determine the degree to which students are a part of the mathematical, linguistic, and other specific "subcultures". Such research will probably make it possible to consider the problem of individual psychological differences.

Developing the conceptions associated with tests of mental development, we will have to review the system of criteria employed (standardization, reliability, validity). In particular we will have to reexamine the traditional idea that the psychological test results acquired with large samples should supposedly distribute themselves as a Gaussian curve--that is, as a normal distribution. This idea obviously has no serious grounds, and thus we cannot but agree with the criticism to which it is subjected by Hofmann (14). Without going into all of the ramifications of the question, we should note that a normal distribution exists when a large number of diverse factors act upon a random variable, and when the proportion of the influence exerted by each factor is identically low in comparison to their number (see (11)). But an entirely different pattern can be seen in intelligence testing: In addition to numerous diverse factors, one very powerful factor--the culture factor--also affects the distribution. In this case the distribution of the testing results would depend on the proportionate representation, within the given sample, of persons exhibiting different degrees of affinity to the culture reflected in the test; because the characteristics of the set of subjects cannot be predicted, nothing can be said of the nature of the distribution beforehand either. On occasion a normal distribution may arise, but this would be the exception, and not the rule.

Understandably, a distribution differing from normal poses a large number of difficulties to the psychologist; the main one is that he would have no grounds for applying parametric statistical methods. He would probably have to refrain from making comparisons with any criteria when such comparisons are based on groups created according to an inherent criterion, for example the standard deviation. Obviously the psychologist will have to switch to other means of comparison, ones which, incidentally, would seem more adequate and up-to-date (see for example (16)).

We can no longer be satisfied with the evolved definition of the reliability criterion, according to which the greater the agreement between testing and re-testing, the higher is the quality of the test. This criterion bears within itself the notion of metaphysical constancy of the content of the mind, and it does not allow for its development. The new definition of tests suggested here is based on the notion that acquisition of verbal-logical skills presupposes development of thinking. A high reliability coefficient with retesting should more likely be perceived as a signal of trouble: Either the test does not reflect changes that had occurred in the mind, or such changes had in fact not occurred, but this would mean a pause in development, which could not but alarm the psychologist.

The thoughts presented here concerning reexamination of the methodological machinery of psychological diagnosis provide only one particular impression of the paths of future research. For the moment we can only discuss them tentatively.



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As with other techniques of psychological diagnosis, tests require further research. Without a doubt, in addition to those indicated here, other ways for improving tests are possible. What I am asking is not to reject tests, but to evaluate them adequately, to open up broad scientific-practical perspectives before them.

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